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Department of
Agriculture

**Forest
Service**

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Technical
Report WO-20

Forest Insect and Disease Conditions in the United States 1979

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Foreword

This document represents the 29th annual report of forest insect and disease conditions in the United States. It was prepared by the Forest Insect and Disease Management Staff, State and Private Forestry, Washington, D.C., to provide land managers and others with information about the impact, distribution, and trends for major forest insect and disease pests. The report represents the efforts of scores of State, Federal, and industrial foresters, entomologists, and plant pathologists, as well as extension agents, farmers, homeowners, and others interested in recognizing and documenting the incidence and impact of forest pests. We thank them all. We especially thank John Pronos and Bill Hoffard for their time spent in compiling and editing this report. Detailed information on any of the pests discussed in this report can be obtained from the appropriate Forest Service Regional Office.

As our country enters the 1980's, we grow increasingly aware of the expendability of many of our natural resources. As such, our trees—a renewable natural resource—are more important to America than ever before. But with this understanding has evolved an increased appreciation for the delicateness of the environment. A knowledge of the incidence and impact of forest pests is an integral part of the forest management process—a process that involves environmental as well as economic considerations. Toward that end, we hope that *Forest Insect and Disease Conditions in the United States, 1979* proves both practical and interesting.

H. Daniel Brown, *Staff Pathologist*

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This publication reports information involving pesticides. It does not contain recommendations for their use, nor does it imply the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

Caution: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product of service to the exclusion of others that may be suitable.

Common names of the insects discussed in this report are approved by the Entomological Society of America (ESA) or are widely accepted and commonly used. The ESA-approved common names are indicated in the Insect Index. Scientific names of disease-causing agents are changed as additional studies are made. Recently approved new names are listed with the proviously used names in such cases for the information and convenience of the reader.

April 1981

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National Summary of Forest Insect and Disease Conditions, 1979

Eastern Conditions

In 1979, spruce budworm, gypsy moth, and southern pine beetle were the most important forest insect pests in the Eastern United States. Acreage infested by spruce budworm dropped 14 percent from 1978 (7.7 million acres to 6.6 million acres). Nevertheless, damage was heavier in all States except Maine.

Gypsy moth defoliation dropped substantially from 1978. The 654,000 acres defoliated represent a 49-percent decrease from the 1,271,990 acres recorded last year. Except for Vermont, defoliation was heavier in New England but dropped in New York, New Jersey, and Pennsylvania.

In the South, southern pine beetle populations exploded. Heaviest losses occurred in South Carolina, Georgia, Alabama, and Mississippi, where 47,300,000 board feet of sawtimber and 517,400 cords of pulpwood were salvaged. Despite this increase in activity, Texas (scene of extensive beetle kills in the past) and Louisiana reported very few infestations.

Other noteworthy insects included forest tent caterpillar (Alabama, Louisiana, Virginia, Maine, and Minnesota), the oak leaftier complex, introduced pine sawfly (Blue Ridge Parkway of North Carolina), and cankerworms. Additionally, the balsam woolly adelgid was discovered on Mount Rogers in southern Virginia. This pest now infests all natural stands of Fraser fir in the Tennessee-Virginia portion of the tree's range.

Fusiform rust was the most serious disease of the slash and loblolly pine resource. Millions of acres of pine in the South are infected with stem cankers.

Well-managed integrated control programs for Dutch elm disease demonstrated that annual elm mortality can be significantly reduced. Many areas or communities without control programs sustained heavy damage.

Oak wilt continued to spread into previously uninfected areas of the East. The causal fungus was also implicated in the death and decline of live oaks in Texas. The perennial activity of oak wilt resulted in the continuation of quarantine regulations and the enactment of new ones.

New disease centers of both the European and North American strains of Scleroderris canker were found, but these centers were generally located in counties where the disease was previously reported. Quarantines in NewYork and Vermont remained in effect.

White pine blister rust was the most damaging disease of white pine in the East, but with proper site selection and use of resistant stock, land managers can successfully grow white pine.

Diebacks and declines, mostly from unknown causes, injured various eastern hardwoods, including ash, oak, maple, paper birch, and walnut.

Mortality caused by pitch canker decreased to moderate levels in many pine plantations. However, there was severe damage reported in Florida seed orchards.

Weather damage caused serious tree losses at many locations in the South. Among the damaging agents were winter drying, snow, ice, drought, tornados, and hurricanes.

The pine wood nematode was found in the United States for the first time. It was generally restricted to ornamental trees, and the damage it may cause in forest trees is unknown. It is thought to be a native pest and not introduced from Japan where it is epidemic in forest stands.

Western Conditions

In the West, the mountain pine beetle and the spruce budworm continued as the most significant forest insects.

Mountain pine beetle activity was variable, increasing in some areas and declining in others. The Intermountain Region showed some of the most dramatic increases with over 5 million lodgepole pines lost in central Idaho and Wyoming. The beetle continued to be the most destructive insect in the Rocky Mountain Region where widespread ponderosa pine mortality occurred along the Colorado Front Range and in the Black Hills of South Dakota. In the Northern Region, beetle activity increased in Montana but decreased in northern Idaho. Abnormally cold temperatures served to reduce the number of successfully attacked trees.

Spruce budworm activity was also mixed. In northern Idaho and western Montana, defoliated acreage dropped 10 percent from 1978, but infestations continued severe on Colorado's Front Range. In the Southwest, infested acreage increased 70 percent, with heaviest damage on the Grand Canyon National Park and the Kaibab and Carson National Forests. The Intermountain Region saw budworm defoliation increase by a quarter of a million acres with the Salmon, Targhee, and Boise National Forests among areas hardest hit. In the Pacific Northwest, budworm-defoliated acreage doubled to 400,000 acres with damage heavy on the North Cascades, Okanogan National Forest, and Warm Springs Indian Reservation.

Western pine beetle caused widely scattered mortality throughout the Southwest and California. In the Pacific Northwest, activity increased in eastern Washington but declined

in Oregon. Losses in the Intermountain Region were minimal.

Douglas-fir tussock moth defoliation dropped off sharply in the Southwest and also declined in California. In the Rocky Mountains, damage was confined to urban areas of the Front Range. Poplulations were low in Montana and the Pacific Northwest.

In Alaska, the spruce beetle dramatically increased in 1979 to cover about 370,650 acres (an increase of 247,100 acres over 1978). Large aspen tortrix populations remained high for a second consecutive year.

The dwarf mistletoes, as in previous years, caused serious losses to commercial conifers in the West and Alaska. The major impact of this group of diseases is growth reduction. Estimates indicate that over 18 million cubic feet of wood are lost to dwarf mistletoes each year in the Southwest. Forty-two percent of the host type in Oregon and Washington is infected. Field surveys and computer yield programs were used to determine economically feasible management strategies for dwarf mistletoe infected stands. The incorporation of mistletoe control procedures into silvicultural prescriptions is becoming more common.

Root diseases accounted for major tree losses in most Western areas. The majority of damage was attributed to laminated root rot, annosus root rot, armillaria root rot, and black stain root disease. On certain sites more than 25 percent of the trees are infected with annosus root rot. Root disease was often associated with pest management activities and tree wounding, and, in general, observations suggest that these problems are becoming more serious.

Needle diseases were more visible in many locations, but in the Pacific Northwest incidence declined. There may be growth losses in situations of extreme or repeated defoliation.

Winter injury was very common throughout the West and was the most spectacular tree damaging agent in the Northwest. The severity of injury was great enough in some cases to cause mortality; seedlings often suffered the most damage.

Light to moderate damage from damping off fungi, water molds, gray mold, and low temperatures was reported in many tree nurseries.

Other pest problems of local significance included air pollution, Dutch elm disease, spruce needle rust, comandra blister rust, and rodents.

Areas of heaviest mountain pine beetle activity. Scattered damage was also reported from Arizona, New Mexico, and California.

Areas of heaviest western spruce budworm infestations.

Forest Insect and Disease Conditions by Region

Northern Region (R-1)[1]

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Conditions in Brief

In Region 1, the area covered by mountain pine beetle infestations increased in Montana but decreased in Idaho. Extremely cold temperatures caused a marked reduction of successfully attacked trees. Douglas-fir beetle populations increased in both Idaho and Yellowstone National Park, and western balsam bark beetles killed trees in the higher elevations of Montana.

Damage by defoliators was mixed in 1979. Total visible acreage defoliated by western spruce budworm dropped 10 percent under 1978 figures, but sawflies and larch casebearer severely defoliated several areas in northern Idaho. Douglas-fir tussock moth trapping captured only a few male moths, indicating that populations will remain endemic for at least another year.

Populations of pine butterfly, gouty pitch midge, and a ponderosa pine needle miner essentially collapsed.

Winter damage was widespread in northern Idaho and western Montana. Snow mold on Douglas-fir was locally prevalent throughout the Region for the first time. A Douglas-fir needle blight occurred in northwestern Montana. Lodgepole pine needle cast, although widespread, was locally severe only in northern Idaho. A closely related needle cast caused severe defoliation of whitebark pine in central Montana.

Discoloration caused by Meria needle cast and Dothistroma needle blight declined notably. Gray mold caused damage to western larch in both nursery beds and greenhouses. Rodents girdled about 25 percent of western larch saplings left after thinning in northwestern Montana. Activity of dwarf mistletoes, stem and root decays, stem rusts, and cankers did not fluctuate significantly.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopkins, expanded its infestation area in Montana but decreased in Idaho. In most areas, extremely cold temperatures caused a significant reduction in successfully attacked trees. Size of outbreak areas on the Beaverhead, Gallatin, Flathead, and Kootenai National Forests increased, but remained static on the Lolo National Forest. On the Glacier and Yellowstone National Parks, significant area expansion occurred.

More specific status and 1979 impact of mountain pine beetle in the most important outbreak areas follows:

Beaverhead National Forest (Madison Ranger District). Over 119,000 acres of lodgepole and whitebark pine were infested (an increase of 39,000 acres over 1978). Beetle populations will increase in 1980.

Gallatin National Forest (Hebgen Lake, Bozeman/Gallatin, and Gardiner Ranger Districts). Millions of lodgepole pines were killed over 441,000 acres. Mortality was especially severe in whitebark pine stands at high elevations. The epidemic will expand on most Districts except for Hebgen Lake where it should remain static. Mortality on the northern portion of the Bozeman/Gallatin District will decline due to host depletion.

Flathead National Forest and Glacier National Park. Despite unusually cold temperatures, the massive infestation on the Flathead National Forest and Glacier National Park expanded. Infestation area increased from about 164,000 to more than 215,000 acres in the park, and from about 109,000 to 123,000 acres on nearby Forest, State, and private lands. The infestation will intensify and spread eastward in 1980.

Kootenai National Forest. Infestation area in lodgepole and ponderosa pine types increased from nearly 30,000 to 49,000 acres. Nevertheless, outbreak intensity within the outbreak area declined 50 percent with 11 trees infested per acre. Increased losses in 1980 are expected.

Lolo National Forest (Plains Ranger District). The infestation increased about 27 percent from 11,000 acres in 1978 to 14,000 acres in 1979. Newly attacked trees averaged 30 per acre. Over one-half million trees could be lost in 1980.

Yellowstone National Park. The size of the Yellowstone infestation increased by a factor of 2.5. Several million lodgepole and whitebark pines were killed on about 431,000 acres. Infestation will increase in 1980.

Lewis and Clark National Forest (and nearby BLM, State, and private lands). Infestations in old growth ponderosa pine type declined from 64,400 to 24,000 acres, but nearly 24,000 trees were killed. Drought in 1979 may increase stand susceptibility and result in increased 1980 mortality.

Bureau of Land Management Lands (north of Lewiston, Mont.). An average of one tree per acre was killed in second growth ponderosa

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[1] Includes forests in Montana, northern Idaho, North Dakota, and northwestern South Dakota and National Park Service lands in northwestern Wyoming.

pine stands on 8,600 acres in the Judith Mountains. Groups of faders ranged from 2,000 to 3,000 trees per group. Infestations may increase in 1980.

Blackfoot River Drainage (east of Missoula, Mont.). Several thousand trees were killed on State and private lands.

Bureau of Land Management Lands (south of Lewiston, Idaho). Thousands of trees were killed over 1,700 acres. Nevertheless, infestations are down from 1978. This outbreak should remain static in 1980.

Bitterroot National Forest. About one tree per acre was killed over 1,600 acres. Infestations declined in the Idaho primitive area of the Magruder Ranger District. Drought stress may result in increased 1980 losses.

Crow Indian Reservation. Infestation in second-growth ponderosa pine stands declined from about 7,000 to 1,700 acres in this southeastern Montana reservation. Nevertheless, the number of infested trees per acre increased from 7 to 39. Here too, drought is expected to contribute to increased 1980 losses.

Douglas-fir tussock moth, *Orgyia pseudotsugata* (McDunnough). Tussock moth populations remain endemic in the Region. Pheromone baited sticky traps at 28 locations captured only a few male moths. Survey results do not indicate an epidemic population next year.

Western spruce budworm, *Choristoneura occidentalis* Free. The budworm epidemic declined in northern Idaho and western Montana except for the Lolo National Forest and the western portion of the Helena National Forest. East of the Continental Divide, defoliated areas increased except in the Yellowstone National Park and eastern portion of the Helena National Forest. The area of defoliation visible from the air decreased from 1978 from a total of 2,520,000 to 2,271,000 acres (table 1). Budworm egg mass surveys on the Lolo, Helena, Beaverhead, and Custer National Forests indicate a high overwintering population.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins. Populations increased in overmature Douglas-fir stands on the Elk City and Fenn Ranger Districts of the Nezperce National Forest. In Yellowstone National Park near Gardiner, Mont., beetles killed several hundred trees that had been top killed and defoliated by western spruce budworm the previous 7 to 8 years. In the case of both the National Forest and National Park, tree mortality is expected to increase in 1980.

Forest tent caterpillar, *Malacosoma disstria.* Aspen stands in the Turtle Mountains of North Dakota have been severly defoliated since 1976. This year, however, only scattered defoliation occurred, mostly in 30- to 80-acre patches.

Status of Diseases

Dwarf mistletoes, *Arceuthobium* spp., were again a major problem in the Region during 1979. An estimated 93 million cubic feet of annual growth loss was attributed to *A. americanum* Nutt. on lodgepole pine, *A. douglasii* Engelm. on Douglas-fir, and *A. larieis* (Piper) St. John on western lodgepole pine.

Root diseases were significant problems in 1979 and caused ap-

Table 1.— *Acres of aerially visible[1] western spruce budworm defoliation in the Northern Region in 1978 and 1979*

Unit[2]	Acres of visible defoliation		Changes in size of infestation area
	1978	1979	
	Acres		
North Idaho			
Clearwater NF	8,115	0	– 8,115
Idaho Panhandle NF	7,416	0	– 7,416
Nezperce NF	4,590	0	– 4,590
Subtotal	20,121	0	– 20,121
Montana			
Beaverhead NF	223,720	349,889	+126,169
Bitterroot NF[3]	379,112	95,332	–283,780
Custer NF	3,625	5,373	+ 1,748
Deerlodge NF	382,762	402,638	+ 19,876
Flathead IR	50,566	3,523	– 47,043
Flathead NF	15,171	1,803	– 13,368
Gallatin NF	293,265	325,921	+ 32,656
Helena NF	575,151	463,175	–111,976
Kootenai NF	14,604	1,438	– 13,166
Lewis & Clark NF	176,294	211,493	+ 35,199
Lolo NF	281,161	335,312	+ 54,151
Subtotal	2,395,431	2,195,897	
Wyoming			
Yellowstone NP	104,694	75,525	– 29,169
Grand Total	2,520,246	2,271,422	–248,824

[1]Aerially visible defoliation occurs when 25 percent or more of current foliage is destroyed.
[2]Includes Federal, State, and private land.
[3]A portion of this Forest is in north Idaho. (About 10,000 acres in northern Idaho were defoliated in 1979 compared to about 35,000 in 1978.)

Other insects (R-1)

Insect	Host	Location	Remarks
Western larch sawflies *Anoplonyx* sp. *Pristiphora erichsonii* (Hartig)	Western larch	Northern Idaho Panhandle National Forest land and south of Newport, Wash. Also some activity in Montana	Nearly 14,000 acres infested. Associated with larch casebearer and needle diseases.
Cankerworms *Paleacrita vernata* (Peck) and *Alsophila pometaria* (Harris)	Siberian elm	North Dakota	Continued to defoliate shelterbelts.
Pine butterfly *Neophasia menapia* (Felder & Felder)	Ponderosa pine	Western Montana	Outbreak that started in early 1970's has ended. No defoliation was noticeable from the air.
Gouty pitch midge *Cecidomyia pinniinopsis* O.S.	Ponderosa pine	Northern Idaho	Only scattered injury to new shoots occurred this year.
Pine needle sheath-miner *Zelleria haimbachi* Busck	Ponderosa pine	South of Helena, Mont.	Light defoliation occurred over about 18,000 acres.
A budworm *Argyrotaenia* sp.	Mountain hemlock and other conifers	Wallari, Idaho, to Noxon, Mont.	Spread to about 1,500 acres. Caused severe defoliation in saplings and pole-size timber.
Western balsam bark beetle *Dryocoetes confusus* Swaine	Subalpine fir	Beaverhead, Gallatin, Flathead, and Lewis and Clark National Forests and Yellowstone National Park	Infested area increased from 6,300 to 7,900 acres. Heaviest impact was in high elevation stands.
Larch casebearer *Coleophora laricella* Hubner	Western larch	Northern Idaho	Many stands were defoliated with most damage near lakes and river drainages.
Mountain pine cone beetle *Conopthorus monticolae* Hopkins	Western white pine	Sandpoint, Idaho, seed orchard	Destroyed nearly all of the seed crop.
Coneworm *Dioryctria* sp.	Ponderosa pine	Seed orchards throughout Region	Caused heavy losses in orchards throughout the Region.
Ponderosa pine needle miner *Coleotechnites* sp.	Ponderosa pine	Western Montana	No defoliation from this pest occurred this year.

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proximately 87 million cubic feet of volume loss. Fungi responsible for damage to commercial conifers included *Phellinus weirii* (Musr.) Gilbertson, *Armillariella mellea* (Vahl ex Fr.) Karst., and *Phaeolus schweinitzii* (Fr.) Pat.

Needle casts. Lodgepole pine needle cast, *Lophodermella concolor* (Dearn.) Darker, although locally severe in northern Idaho, was generally of light intensity in lodgepole pine in the remainder of the Region.

Another needle cast, *Lophodermella arcuata* (Darker) Darker, caused severe defoliation of white bark pine on east side forests, particularly in the King's Hall area of the Lewis and Clark National Forest.

Discoloration of conifers caused by other needle pathogens remained static or declined. Most notable in the decline category was Meria needle cast, *Meria laricis* Vuill., on western larch and Dothistroma needle blight, *Scirrhia pini* Funk & A. K. Parker, on ponderosa pine.

Douglas-fir needle blight, *Rhabdocline weirrii*, Parker & Reid. A needle pathogen occurred on Douglas-fir in the Libby and Columbia Falls areas of northwestern Montana. Symptom development was similar to that of the common Christmas tree blight, which is normally seen in the spring and early summer on the previous year's needles. In this case, several age classes of needles were affected, and the symptoms were not seen until midfall. The pathogen is closely related to the Christmas tree blight fungus, *Rhabdocline pseudotsugae* Syd.

Snow mold, *Phacidium infestans* Karst., on Douglas-fir was locally prevalent throught the Region for the first time. Initial symptoms were a bright yellowing or browning of older needles in the lower crown in March and April. Affected needles remained on trees throughout the summer and turned brown or almost gray with several rows of small, dark brown fruiting bodies. Young trees with lower branches that had been covered by snow were most severely affected. Some growth loss, but little mortality, will result from infection.

Winter damage to conifers was widespread in northern Idaho and western Montana. Areas with severe damage included Priest Lake, Bull Lake, Libby, upper Lochsa River, and lower Blackfoot River. Discoloration frequency and severity varied by area, microsite, and species. In order of decreasing susceptibility, trees affected were: western hemlock, western white pine, western red cedar, grand fir, ponderosa pine, and Douglas-fir. Lodgepole pine, subalpine fir, and Engelmann spruce were seldom affected. Small trees in openings were most severely affected.

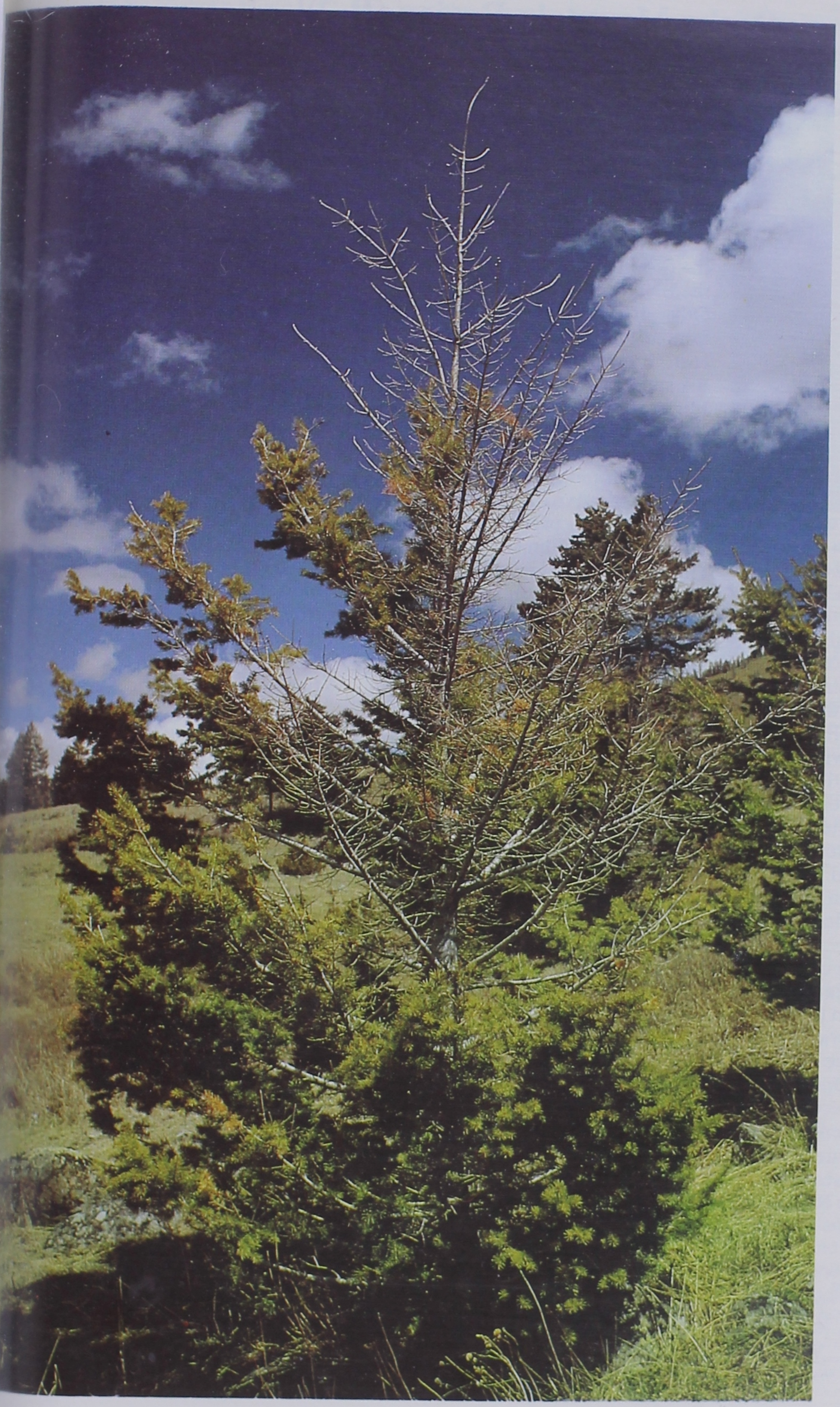
Injury varied from a loss of a few needles to reddening of the entire crown. Unless other stress factors are imposed, most defoliated trees should recover the following summer.

Nursery diseases. At the Coeur d'Alene nursery, gray mold, *Botrytis cinerea* Pers. ex. Fr., caused widespread and nearly complete defoliation of 2-0 western larch. In most instances seedlings were not killed, but put on new foliage and developed normally. Loss estimates were unavailable.

At the Coeur d'Alene nursery greenhouse and in other greenhouse operations in the Region, gray mold could be found causing defoliation, but apparently conditions necessary for serious losses were not reached. The most commonly affected species was western larch but a few 2 to 3 needle pines occasionally had girdled stems.

Animal damage. Rodents girdled sapling-size western larch in thinned and unthinned stands on the Eureka Ranger District, Kootenai National Forest, Mont. As many as 25 percent of the residual stems in thinned areas had dead tops.

In Region 1, the dwarf mistletoes reduce growth by nearly 93 million cubic feet each year.



Winter injury in Montana.

F-702370

Rocky Mountain Region (R-2)[1]

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Conditions in Brief

The mountain pine beetle continued to be the most destructive forest insect pest within the Region and caused substantial ponderosa pine mortality along the Colorado Front Range and in the Black Hills of South Dakota. Beetle infestations increased on the southern portion of the Shoshone National Forest in Wyoming. Some ponderosa pine mortality was also detected on the Bighorn National Forest in Wyoming. Programs to suppress mountain pine beetle activity using silvicultural management methods are ongoing in Colorado and South Dakota.

The western spruce budworm continued to be a serious defoliator of Douglas-fir and white fir within the Region. The major infestation occurred along the Colorado Front Range. Small infestations were detected in the San Juan National Forest, Colo., and the Shoshone National Forest, Wyo. Repeated defoliation by the budworm was readily evident in many areas.

The jack pine budworm caused moderate to severe defoliation of 2,400 acres of jack pine on the Bessey District of the Nebraska National Forest. This was the first outbreak of the budworm ever reported for this area.

Lodgepole pine dwarf mistletoe and comandra rust continued to be the most significant diseases in the lodgepole pine type of the Rocky Mountain Region. Annosus root rot of true firs, black stain root disease of pinyon pine, and Armillaria root rot in all major forest types are currently being evaluated to obtain distribution and loss figures for the Region. Diplodia tip blight was reported for the first time on ponderosa pine in the Black Hills of South Dakota. Other diseases observed in the mountainous regions were western gall rust, Cryptosphaeria canker of aspen, ink spot disease of aspen, aspen leaf blight, cottonwood leaf rust, Cercospora blight of juniper, and Dothistroma needle blight.

The Colorado State Forest Service and Cooperative Extension Service continued their participation in the Federal Dutch Elm Disease Demonstration Project. A fifth community was added to the demonstration program.

Other diseases present in the Great Plains included heartrot of green ash, honeylocust canker, Russian olive canker, Cytospora canker of cottonwood, a bacterial canker of cottonwood, hackberry decay, oak wilt, and honeysuckle blight.

In Kansas, the pine wood nematode was observed for the first time. Additional surveys are planned for 1980.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopkins. This bark beetle continued to be the most significant forest insect pest of the region. The epidemic in the northern Black Hills continued to ravage ponderosa pine through 1979. The southern half of the Bear Lodge Mountains showed a 4:1 increase in tree mortality from 1978 levels, with 5.8 trees per acre infested. Limestone Plateau surveys indicated a decreasing population trend. The ratio of 1979 to 1978 infested trees was 0.4:1 with an average of 0.3 infested trees per acre.

On 30,000 acres of State, private, and Federal lands in the area around Lead and Deadwood, S. Dak., tree mortality increased by a ratio of 1.3:1 from 1978 to 1979 with an average of 0.8 infested trees per acre. Throughout most of the southern portion of the Black Hills, populations were at endemic levels.

On the Shoshone National Forest in northwestern Wyoming, mountain pine beetle activity increased in the southern part of the Forest southwest of Lander.

Pockets of beetle-infested ponderosa pine were detected along the

F-702371

Ponderosa pine near Boulder, Colo., defoliated by a needleminer, Coleotechnites *sp. Note intermixed red trees killed by the mountain pine beetle.*

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[1]Includes forests in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming.
[2]The following organizations contributed information for this report: Colorado Department of Health; Colorado State Forest Service; Colorado State University; Kansas State University and Cooperative Extension Service; Nebraska State and Extension Forestry; South Dakota Division of Forestry; and U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station.

eastern slope of the Bighorn Mountains.

Of 1,400,000 acres of ponderosa pine type in the Colorado Front Range, an estimated 25 percent showed detectable infestations of mountain pine beetle. Within these infested areas, about 420,000 pines (1.2 per acre) were attacked by the beetle in 1978, with 96,000 of these trees salvaged or chemically treated. In addition to these direct controls, preventive thinnings were made in intensively managed areas to help prevent future epidemics.

Western spruce budworm, *Choristoneura occidentalis* Freeman. The budworm defoliated about 930,000 acres of Douglas-fir and white fir in Colorado and continued to be a serious problem on the Front Range. The San Isabel and San Juan National Forests showed areas of light defoliation with moderate to heavy defoliation on the Pike, Arapaho, and Roosevelt National Forests. Front Range populations will remain static in 1980. Insufficient data are available to predict 1980 population trends elsewhere in Colorado.

On the Clarks Fork District of the Shoshone National Forest, light defoliation was reported. Top-kill was evident in pure Douglas-fir stands on the Arapaho National Forest in Colorado. Damage from budworm defoliation was negligible in other areas surveyed.

Jack pine budworm, *Choristoneura pinus* Freeman. Jack pine budworm heavily defoliated about 1,100 acres of jack pine on the Bessey District of the Nebraska National Forest. Light to medium defoliation occurred on the remaining 1,300 acres of jack pine. Egg mass sampling in August indicated a potential for continued high budworm populations in 1980.

Pine tip moths, *Rhyacionia bushnelli* (Busch), *R. frustrana* (Comstock), and *R. neomexicana* (Dyar). Pine tip moths damaged ponderosa pine in the Black Hills and Shelterbelt plantings throughout the area east of the Missouri River. Nantucket pine tip moth populations in Kansas were apparently the lowest in 7 years. Damage to pines in shelterbelts and Christmas trees in Kansas was not severe this year.

Douglas-fir tussock moth, *Orgyia pseudotsugata* (McDunnough). As usual, Douglas-fir tussock moth activity was confined to urban areas in the Colorado Front Range. Damage to fir in Denver, Boulder, and Colorado Springs was especially apparent.

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Jack pine defoliated by the jack pine budworm, Choristoneura pinus, *in the Nebraska National Forest.*

Status of Diseases

Dwarf mistletoes. A survey to assess incidence, growth loss, and mortality caused by *Arceuthobium americanum* Nutt. ex Engelm. in lodgepole pine in the Rocky Mountain Region was made during

Other insects (R-2)

Insect	Host	Location	Remarks
Zimmerman pine moth *Dioryctria zimmermani* (Grote)	Ponderosa pine	South Dakota, Northwestern Colorado	Probably widespread throughout eastern half of South Dakota and near Clordon in northwest South Dakota. Also found in several northeastern Colorado counties.
Elm leaf beetle *Pyrrhalta luteola* (Muller)	Siberian and American elms	South Dakota, Kansas, Colorado	Common in shade trees in the lower Black Hills and in urban and shelterbelt trees east of the Missouri River. Populations low in urban Kansas but severe in parts of Denver.

Other insects (R-2) continued

Insect	Host	Location	Remarks
Western tent caterpillar *Malacosoma californicum* (Packard)	Aspen	Colorado (Pagosa District of San Juan National Forest)	Defoliated about 16,000 acres on Federal and private lands. Heavy defoliation expected in 1980.
Pine tortrix *Choristoneura lambertiana ponderosana* Obraztsou	Ponderosa pine	Colorado (Roosevelt and Pike National Forests)	Defoliation was most pronounced along the north fork of the South Platte River.
Aspen leafminer *Phyllocnistis populiella* Chambers	Aspen	Black Hills	Damage occurred throughout north and south Black Hills but was more pronounced in the north. No apparent host mortality.
Pine engraver beetles (*Ips* spp.)	Ponderosa pine	Keystone, S.Dak.; Nemo Ranger District, Black Hills National Forest	Killed about 30 percent of residual stand following thinning operation. Mortality also associated with prescribed burns and construction damage.
Western balsam bark beetle *Dryocoetes confusus* Swaine	Subalpine fir	Colorado, Wyoming	Damage throughout these two States but worse on Colorado's western slope.
Pine needle miner *Coleotechnites* sp.	Ponderosa pine	Boulder, Jefferson, and Larimer counties along the Colorado Front Range	Caused prominent damage.
Flatheaded cedar borer *Chrysobothris texana* L.	Eastern redcedar	Southwestern Kansas	Associated with widespread shelterbelt mortality.
European pine sawfly *Neodiprion sertifer* (Geoffrey)	Scots pine	East central Kansas	Large populations (probably highest levels ever recorded in Kansas) damaged Christmas trees throughout this area.
Linden looper *Erannis tiliaria* (Harris)	Various hardwoods	Lincoln County, S.Dak.	In combination with another caterpillar, this looper defoliated about 1,000 acres in Newton Hills State Park.
Pinyon needle scale *Matsucoccus acalyptus* Herbert	Pinyon pine	Rio Grande National Forest, Colo.	Widespread over about 150 acres near Cottonwood Creek on the Saguache Ranger District.

1977-79. The survey revealed that over 50 percent of the stands were infested. Associated merchantable cubic foot volume loss will be developed at a later date. The southernmost known incidence of this disease in the central Rocky Mountains is West Pass Creek, north of Cochetopa Pass on the Cebolla Ranger District, Gunnison National Forest.

During 1978-79, presuppression surveys for dwarf mistletoe were conducted by the Bureau of Land Management on over 7,000 acres (397 stands) of lodgepole pine type in the vicinity of Independence Mountain, northwest of Cowdrey, Colo. Sixty-two representative stands were processed through the Rocky Mountain Yield (RMYLD) program to estimate total merchantable yields with and without dwarf mistletoe control treatements. For several stands, one or two intermediate cuts to remove dwarf mistletoe infected trees in the overstory made the difference as to whether or not merchantable sawtimber volume could be produced over the rotation age of these stands.

In 1979, surveys for lodgepole pine dwarf mistletoe on the Cebolla and Taylor River Ranger Districts, Gunnison National Forest, were contracted. The survey area included 30,000 acres of lodgepole pine type. Tree and dwarf mistletoe data will be summarized, and yield of each stand will be projected using the RMYLD simulation program. Prescriptions for management activity will be developed after analysis of the program statements.

Dwarf mistletoe-infected lodgepole pine residuals were felled in several clearcut units (512 acres) on the Wind River Ranger District, Shoshone National Forest. Similar overstory removal operations are planned on an additional 800 to 900 acres in 1980.

Root diseases. Annosus root rot, *Heterobasidion annosum* (Fr.) Bref. (=*Fomes annosus* (Fr.) Cke.) surveys were intensified to evaluate occurrence and impact of this disease of true fir. The fungus was found within most white fir stands surveyed in southern Colorado, and was also found in subapline fir located near infected white fir on the San Isabel National Forest. Most trees infected with *H. annosum* had been attacked by bark beetles (*Scolytus ventralis* and/or *Dryocoetes confusus*). Trees of all ages were killed, with greater mortality occurring within cutover stands.

Armillaria root rot, *Armillariella mellea* (Vahl. ex Fr.) Karst., was common on many different conifer hosts within the Rocky Mountain Region. The disease was associated with subalpine fir mortality throughout the range of the host tree in Colorado and Wyoming. Certain portions of the Grand Mesa National Forest had extensive subalpine fir mortality. *A. mellea* diseased trees were often attacked by the western balsam bark beetle (*Dryocoetes confusus*).

Black stain root disease, *Ceratocystis wageneri* Goheen and Cobb(=*Verticicladiella wagenerii* Kendrick) was common on pinyon pine west of the Continental Divide in Colorado. Aerial surveys of the Mesa Verde National Park in the spring of 1979 revealed fewer recently fading trees than in previous years. Many of the trees killed the previous year had lost their foliage from extensive snow and rainfall. Preliminary evaluations to determine longevity of the fungus in recently killed trees and the role of insects in disease epidemiology were initiated.

Black stain disease centers on the San Juan National Forest, Dolores Ranger District, had considerable impact on the McPhee Reservoir Recreation Project. The severity of the disease resulted in the removal of one area from consideration as a recreation complex and the possible redesigning of an alternate area.

Rust diseases. Comandra blister rust, *Cronartium comandrae* Pk. was the second most important disease problem to the management of lodgepole pine within the Region. A roadside survey made within lodgepole pine type on National Forests revealed that 25 percent of the miles traversed were within rust-infested stands. Mortality of young lodgepole pine during a 5-year study in Wyoming was 23.4 percent.

Western gall rust, *Endocronartium harknessii* (J.P. Moore) Y. Hirat.

F-702381

Black stain root disease.

F-702384

Comandra blister rust spores on lodgepole pine.

Since 1971, a 1,000-ponderosa pine seedling (2-0) sample has been collected from the USDA, Forest Service Bessey Nursery, located in Halsey, Nebr., to determine the levels of infection by western gall rust in nursery stock inspected and cleared for shipment to the National Forests. Evaluation of four 1,000-tree samples indicated a very low incidence of infected seedlings (0-0.5 percent). Apparently seedlings became infected by spores released from galled windbreak ponderosa pine adjacent to the nursery. An annual program to rogue out rust galls and heavily infected trees adjacent to the nursery should keep infection levels of nursery stock at a tolerable level.

Western gall rust continued to be an important disease of ponderosa pine in the Black Hills of South Dakota and the Nebraska National Forest. Severely infected trees were often killed with the aid of bark beetles.

Diplodia tip blight, *Diplodia pinea* (Desm.) Kickx. was found for the first time on ponderosa pine within areas of the eastern and southern Black Hills of South Dakota. Appearance of the disease coincided with weather conditions ideal for infection and buildup of the pathogen. This disease was common on ornamental and windbreak Austrian pine in the eastern portions of South Dakota, Nebraska, and Kansas. The pathogen was also found occasionally on ponderosa pine in these areas.

Vascular wilts. Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor.. The Colorado State Forest Service and the Cooperative Extension Service continued participation in the Federal Dutch Elm Disease Demonstration Project. The 1979 project year with four of five Colorado demonstration communities showing a reduction in the Dutch elm disease infection rate. Of these four communities, three—Eaton, Grand Junction, and La Junta, had significant reductions, while the fourth—Yuma, showed a slight improvement in an already good program. The fifth community—Canon City, had a sharp rise in its infection rate. Slow tree removal is thought to be the main reason for the rise.

Total large-leaf elm removals (positive cases plus beetle-commdemned trees) were under 10 percent of the total elm population in all cases and were as low as 1.9 percent in Junta and Yuma. The 22.4-percent elm loss in Eaton during 1978 decreased to 6.4 percent in 1979.

Colorado's Utilization Program involving the sawmilling of urban elm trees into useable wood products was not feasible. The main drawbacks were the difficulty of obtaining suitable logs from elm trees and the failure of the metal detection equipment.

Oak wilt, *Ceratocystis fagacearum* (Bretz) Hunt was found on post oaks near Paola, Kan. (Miami County). This endemic disease was found scattered throughout eastern portions of Nebraska and Kansas near the Missouri River. The disease was most serious when high-value trees were killed in residential areas.

Cytospora canker, *Cytospora chrysosperma* (Pers.) F. Cottonwood plantations in eastern Kansas, which displayed heavy cytospora canker infection during previous years, were damaged to a lesser extent this past year. Many infected trees appeared to "outgrow" the disease. The occurrence of more satisfactory growing conditions, especially moisture, may have been important in the apparent recovery of some infected trees.

Abiotic diseases. The Air Pollution Control Division (Colorado Department of Health) found that ozone levels in the Denver metropolitan area were lower in 1978 than in 1977. Data for 1979 is still being evaluated. There was insufficient monitoring outside the Denver area to determine trends in other parts of Colorado. Foliar symptoms resembling oxidant damage were found on ponderosa pine near Denver.

Ponderosa pine exhibiting needle tip dieback and reddening of foliage was found throughout northwestern Nebraska within and adjacent to Pine Ridge and on the Bessey District of the Nebraska National Forest in north central Nebraska. Weather records and general tree symptoms implicated extremely cold winter temperatures or winter drying as possible causes of this damage.

Winter burn occurred throughout South Dakota this year because of the recordbreaking cold winter. Evergreens on the prairie were most seriously affected. Ornamental arborvitae plants were burned severely, often enough to cause mortality. A number of native ponderosa pines on marginal sites around the Black Hills also suffered winter burn.

Many native ponderosa pine trees in Rapid City, S. Dak., subdivisions succumbed to construction damage. This was likely caused by the extremely dry spring. Related problems were drain-field flooding of native pines and increased salt damage from private driveways and subdivisions.

Pine dieback and mortality, of uncertain cause, have occurred throughout Kansas since pines were introduced and have worsened with the increase in pine plantings. Damage in 1979 was considerable. Scots and Austrian pines in the western half of Kansas were commonly affected. It is believed the unusually high mortality in 1979 resulted from a combination of winter and drought stress.

Nursery diseases. Mortality of containerized Austrian pine seedlings within the Kansas State and Extension Forestry greenhouse (Manhattan) was reported. Necrosis began on the terminal buds and progressed down the main shoot resulting in seedling death. Major fungal associates included *Rhizoctonia* sp., *Cytospora* sp., *Verticillium* sp., and *Genicularia* sp. Chemical control procedures using PCNB (pentachloronitrobenzene) were initiated.

Cottonwood cuttings grown in rooting beds at the Kansas State and Extension Forestry Nursery (Manhattan) displayed stem cankers and occasional mortality. Fungi associated with cankers included *Cytospora* sp., *Alternaria* sp., *Verticillium* sp., *Curvularia* sp., and *Phomopsis* sp. Soil

fumigation and fungicide control trials were initiated.

Tip dieback of 1-0 Engelmann spruce seedlings at Bessey Nursery, Nebraska, was reported. Necrotic tissues were apparently damaged by extremely cold winter temperatures or spring frosts and then colonized by facultative parasitic fungi such as *Phoma* sp., *Alternaria* sp., and *Fusicladium* sp.

Chlorosis and mortality of 1-0 lodgepole pine seedlings at Bessey Nursery, Neb., were associated with soil nutrient imbalances and infection by *Phoma* sp. Excessive overhead irrigation, used primarily for wind erosion control, caused accumulation of soil around the base and on the foliage of some seedlings. These conditions were ideal for attack and damage by *Phoma* sp.

Mt. Sopris Tree Nursery (USDA Forest Service) was fumigated using methyl bromide and chloropicrin at 400 pounds per acre. Fumigation was necessary because of high seedling losses caused by weeds and pathogenic fungi. Fumigation was done in the fall prior to spring seeding. Fumigation dramatically reduced the counts of fungi and weeds detected. In 1978, two seed sources of ponderosa pine were sown in both fumigated and nonfumigated beds. Seedling survival was 3.6 times greater in fumigated areas at the end of the first growing season.

Four tree nurseries in the Region participated during the past 2 years in an evaluation of the ectomycorrhizal fungus *Pisolithus tinctorius* (Pers.) Coker & Couch. The study, coordinated by the Institute of Mycorrhizal Research and Development and FI&DM, includes plans for the outplanting of trees in the spring of 1980. A final report will be available after evaluation of seedling and mycorrhizal survival at outplanting sites.

Pine wood nematode, *Bursaphelenchus lignicolus* Mamiya & Kiyohara. Extensive surveys for the pine wood nematode were conducted by Kansas State Department of Agriculture, in cooperation with the county extension agents and Pittsburgh State University, throughout all the eastern and southern counties of Kansas. Only four positive cases of nematode-killed pines were found, including three Scots pines in Cherokee County and one Austrian pine in Crawford County. No evidence of rapid spread was detected.

Other diseases (R-2)

Disease	Host	Location	Remarks
Ash heart rot *Fomes fraxinophilus* (Peck) Sacc.	Green ash	Great Plains	Widespread occurrence in most stands where green ash is present.
Aspen leaf blight *Marssonina populi* (Lib.) Magn	Aspen	Paonia Ranger District, Gunnison National Forest	Relatively severe defoliation reported on over 800 acres; occurred just before natural leaf fall.
Bacterial canker Unidentified bacterium	Cottonwood and willow	Wilson and Ellis Counties, Kan.	Trees displayed top dieback with girdling cankers on main stem. Symptom development very rapid.
Cercospora blight *Cercospora sequoiae* var. *juniperi* Ell. and Ev.	Eastern redcedar and Rocky Mountain juniper	Eastern Nebraska	Infection at highest level since "dry" years of 1975 and 1976.
Cottonwood leaf rust *Melampsora medusae* Thum.	Cottonwood	Central and eastern Kansas	Common within several energy plantations.
Cryptosphaeria canker & Libertella decay *Cyptosphaeria* sp. *Libertella* sp.	Aspen	Colorado	Produces elongated narrow bole cankers and sapwood decay.

Other diseases (R-2) continued

Disease	Host	Location	Remarks
Diplodia tip blight *Diplodia pinea* (Desm.) Kickx.	Pines	Southeastern South Dakota	Tip mortality.
Dothistroma needle blight *Dothistroma pini* Hulb.	Ponderosa and Austrian pine	Eastern Nebraska and Kansas	1979 levels were highest since "dry" years of 1975 and 1976.
Ink spot of aspen *Ciborinia whetzelii* (Seaver) Seaver	Aspen	Colorado and Wyoming	Endemic throughout aspen range, severe on Conejos Ranger District, Rio Grande, National Forest.
Island chlorosis (Cause unknown)	Hackberry	Northeast and western Kansas	Symptoms similar to nutritional imbalance or a virus disease.
Hackberry decay (Unidentified fungi)	Hackberry	Manhattan, Kan.	Extensive decay in old-growth trees.
Honeylocust canker *Thyronectria austro-americana* (Speg.) Seeler	Honeylocust	Ellis County, Kan.	Progressive dieback with girdling cankers was common in a windbreak.
Honeysuckle blight *Herpobasidium* sp.	Honeysuckle	South Dakota	Caused damage at South Dakota State Nursery and in nearby shelter-belts. Benomyl used for control.
Russian olive canker *Botryodiplodia theobromae* Pat.	Russian olive	Minnehaha County, S. Dak.	Caused cankers and dieback, probably distributed throughout Great Plains.
Taphrina leaf blister *Taphrina* sp.	Hardwoods	Kansas	Most common foliar disease of trees in Kansas. Incidence in 1979 less than in 1978.
Walnut anthracnose *Gnomonia leptostyla* (Fr.) Les. & deNot.	Black walnut	Geary County, Kan.	Disease may limit walnut growth in heavily infected plantations.

Southwestern Region (R-3)[1]

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Conditions in Brief

Tree mortality resulting from bark beetle activity continued in Region 3, but at relatively low levels. Scattered ponderosa pines, singularly and in small groups, were killed by the mountain pine beetle. Mortality by this insect occurred primarily in the northern portions of the Region. Western pine beetle activity, although somewhat lower than last year, continued to cause widely scattered pine mortality throughout the ponderosa pine belt in central and southwestern New Mexico. Roundheaded pine beetle activity continued to decrease, with only localized pockets of tree mortality occurring on the Lincoln National Forest and the Mescalero Apache Indian Reservation, N. Mex. Engraver beetle populations decreased to near endemic levels. Abundant and well spaced precipitation may have helped reduce tree losses caused by *Ips* beetles.

Outbreaks of certain defoliating insects increased in 1979, while others decreased. Acres defoliated by the western spruce budworm increased from 77,000 acres in 1978 to over 131,000 acres in 1979. Areas where the greatest increases occurred included the Kaibab National Forest and Grand Canyon National Park in Arizona and the Carson National Forest in New Mexico.

Douglas-fir tussock moth defoliation of Douglas-fir and white fir decreased markedly on the Santa Fe and Cibola National forests. Only two of the eight tussock moth infestations reported last year continued into 1979. Tussock moth populations in Arizona remained at low levels.

Defoliation by the western tent caterpillar continued on the Santa Fe National Forest, N. Mex., for the fourth consecutive year, and caused moderate to heavy defoliation of aspen.

A pandora moth outbreak, occurring for the first time in 30 years, defoliated 5,120 acres of ponderosa pine on the North Kaibab Ranger District, Kaibab National Forest. The heaviest defoliation occurred about 2 miles west of Jacob Lake, Ariz.

Mortality and growth loss caused by southwestern dwarf mistletoe in ponderosa pine continued to be the two most important effects of forest diseases in the Southwestern Region. Mistletoe surveys were made on approximately 3,100 acres on several National Forests in the Region for input into a simulated yield program (RMYLD). Results from surveys and computer runs were used to train Ranger District personnel in the use of the program and to determine management practices for mistletoe-infected stands.

A control project on the Kaibab National Forest began in 1979. Mistletoe-infected overstory trees on 1,800 acres are to be killed to protect seedlings in plantations installed under the infected trees.

In cooperation with Rocky Mountain Forest and Range Experiment Station and Region 3, researchers from the University of Arizona collected data on the incidence of and growth loss associated with Douglas-fir dwarf mistletoe.

A root disease complex involving two species of fungi caused mortality in corkbark fir on the Apache-Sitgreaves National Forest.

Ponderosa pine seedlings were killed by charcoal root rot in plantations on several Forests. Black stain root disease was confirmed on beetle-killed ponderosa pine by researchers from New Mexico State University. The disease was also identified on dead ponderosa pine in Arizona.

Fusarium sp. caused minor losses in 1-0 ponderosa pine at the Albuquerque Tree Nursery. Large amounts of irrigation water, applied to prevent soil crusting, may have

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Ponderosa pine defoliated by the pandora moth, Coloradia pandora, *on the Kaibab National Forest, Ariz.*

[1] Includes forests in Arizona and New Mexico and National Park Service lands in western Texas.

contributed to the development of the disease. Because of a lack of mycorrhizal formation on seedlings at the Nursery, a study installed in cooperation with the Mycorrhizal Institute in Athens, Ga., was terminated. Populations of possible pathogenic soil-inhabiting fungi and nematodes were monitored at the Nursery.

Aspen shoot blight, aggravated by a wet spring, caused premature defoliation in several areas in the Region.

Abnormally cold winter temperatures caused widespread winter damage to several species of conifers in northern Arizona and New Mexico.

Damage to pine seedlings by gophers and to larger trees by porcupines was common throughout the Region. Bears girdled and killed corkbark fir on the Apache-Sitgreaves National Forest.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopkins caused widely scattered ponderosa pine mortality throughout northern portions of Region 3 (table 2). Tree mortality increased in Arizona, but remained relatively low in New Mexico.

In Arizona, beetles caused increased mortality on the Kaibab Plateau (Kaibab National Forest). Groups of dying and dead trees (totaling up to 30) were evident on the eastern portion of the North Kaibab Ranger District. Because of inaccessibility and environmental constraints, salvage logging was not attempted.

On the north rim of the Grand Canyon National Park, beetles killed pine in groups of 50 to 60 near the junction of Imperial and Cape Royal roads. Elsewhere in the park, groups of 2 to 5 killed trees were widely scattered throughout the area. Forest Service entomologists project continued Grand Canyon losses in 1980. Low levels of activity were also reported in Arizona's Chuska Mountains.

Mountain pine beetle activity continued in Northern New Mexico where isolated infestations took their toll of ponderosa pine. Mortality was reported from the El Rito, Penasco, and Tres Piedras Ranger Districts of the Carson National Forest, and the Cuba, Espanola, Las Vegas, and Pecos Ranger Districts of the Santa Fe National Forest. Some low level activity was also reported on the Navajo Indian Reservation in New Mexico.

Western pine beetle, *Dendroctonus brevicomis* LeC. This bark beetle caused widely scattered tree mortality throughout much of the ponderosa pine belt in central Arizona and southwestern New Mexico.

Table 2. — *Estimated extent (acres) of insect infestations by State and ownership, Southwestern Region, 1979*

Insect	Ownership[1]	Light	Medium	Heavy	Total
A. **Arizona**			Acres		
Western spruce budworm	NFS	34,355	18,099	1,357	53,811
	OF	32,180	1,152	—	33,332
	S	0	0	0	0
	P	0	0	0	0
	(Total)	66,535	19,251	1,357	87,143
Pandora moth	NFS	0	2,432	2,688	5,120
	OF	0	0	0	0
	S	0	0	0	0
	P	0	0	0	0
	(Total)	0	2,432	2,688	5,120
Mountain pine beetle	NFS	—	—	—	40,320
	OF	—	—	—	33,920
	S	—	—	—	0
	P	—	—	—	23,680
	(Total)[2]	—	—	—	97,920
Western pine beetle	NFS	—	—	—	179,200
	OF	—	—	—	0
	S	—	—	—	0
	P	—	—	—	33,120
	(Total)[2]	—	—	—	212,320
Other bark beetles[3]	NFS	—	—	—	38,400
	OF	—	—	—	0
	S	—	—	—	0
	P	—	—	—	9,600
	(Total)[2]	—	—	—	48,000

[1]Ownership: National Forest System (NFS), Other Federal (OF), State (S), Private (P).
[2]Individual trees or groups of dead trees widely scattered over the acreages shown.
[3]Other bark beetles include: Spruce beetle, *Dendroctonus rufipennis* (Kby.); Roundheaded pine beetle, *Dendroctonus adjunctus* Blandf.; *Scolytus* spp.; and *Ips* spp.

Losses remain relatively constant from year to year because natural stress factors (lightning strikes, fire damage, disease, and so on) foster infestations.

In 1979, losses to western pine beetle were heaviest on the Apache-Sitgreaves, Coconino, Kaibab, Tonto, Gila, and Lincoln National Forests, and the Fort Apache and Carlos Indian Reservations.

Western spruce budworm, *Christoneura occidentalis* Free. Areas of visible defoliation increased markedly in Region 3 from an estimated 77,000 acres in 1978 to 131,000 acres in 1979 (table 3). By severity class, defoliation increased in the light to moderate class but decreased in the heavy class. The Kaibab and Carson National Forests and Grand Canyon National Park showed the greatest increase in defoliation. In all areas, the number of egg masses per square meter of foliage increased, indicating a population increase for 1980.

In the Jemez Mountains of the Santa Fe National Forest, sampling continued on a western spruce budworm suppression project. For the third consecutive year, budworm populations remained low in the area treated with carbaryl in 1977. Table 4 shows the population trend of the treated and untreated areas based on the number of larvae per 100 buds and number of egg masses per square meter of foliage.

Douglas-fir tussock moth, *Orgyia pseudotsugata.* In New Mexico, defoliation of Douglas-fir and white fir by Douglas-fir tussock moth dropped off sharply. Only two of last year's eight active tussock moth infestations on the Cibola and Santa Fe National Forests persisted in 1979. No visible additional defoliation occurred in Medio Dia, Cochiti, Nambe, Los Alamos, and Pueblos Canyons (Santa Fe National Forest), however Bear and Trigo Canyons (Cibola National Forest) showed light to moderate defoliation.

New Mexico was the scene of cooperative Federal-State-private suppression projects in which 1,400 acres were treated in Bear Canyon and in the Ellena Gallegos Grant. An aerially applied nucleopolyhedrosis virus reduced populations to acceptable levels.

Tussock moth populations remained low on the Tonto National Forest (Arizona).

Western tent caterpillar, *Malacosoma californicum* (Packard), defoliated aspen stands on the Santa Fe National Forest for the fourth consecutive year. Moderate to heavy defoliation occurred on the Coyote, Tesuque, and Espanola Ranger Districts. Defoliation was severe in and around the vicinity of Los Alamos and Baundelier National Monument, N. Mex. Scattered patches of defoliation also occurred

Table 2 continued.

Insect	Ownership[1]	Light	Medium	Heavy	Total
B. **New Mexico**					
Western spruce budworm	NFS	12,073	15,451	8,108	35,632
	OF	0	0	0	0
	S	0	0	0	0
	P	3,533	5,351	0	8,864
	(Total)	15,606	20,802	8,108	44,496
Western tent caterpillar	NFS	7,040	5,120	3,840	16,000
	OF	0	0	0	0
	S	0	0	0	0
	P	0	0	1,280	1,280
	(Total)	7,040	5,120	5,120	17,280
Mountain pine beetle	NFS	—	—	—	76,160
	OF	—	—	—	0
	S	—	—	—	0
	P	—	—	—	0
	(Total)[2]	—	—	—	76,160
Western pine beetle	NFS	—	—	—	42,240
	OF	—	—	—	0
	S	—	—	—	0
	P	—	—	—	2,560
	(Total)[2]	—	—	—	44,800
Other bark beetles[3]	NFS	—	—	—	32,000
	OF	—	—	—	0
	S	—	—	—	0
	P	—	—	—	1,920
	(Total)[2]	—	—	—	33,920

[1]Ownership: National Forest System (NFS), Other Federal (OF), State (S), Private (P).
[2]Individual trees or groups of dead trees widely scattered over the acreages shown.
[3]Other bark beetles include: Spruce beetle, *Dendroctonus rufipennis* (Kby.); Roundheaded pine beetle, *Dendroctonus adjunctus* Blandf.; *Scolytus* spp.; and *Ips* spp.

Table 3. — *Acres of visible defoliation by western spruce budworm in R-3 for the past 3 years*

Defoliation	1977	1978	1979
Light	177,000	26,000	82,000
Moderate	25,000	30,000	40,000
Heavy	3,000	21,000	9,000
Total	205,000	77,000	131,000

on the Tres Piedras, Questa, Taos, and Penasco Ranger Districts (Carson National Forest).

Pandora moth, *Coloradia pandora* Blake, defoliated 5,120 acres of ponderosa pine on the North Kaibab Ranger District, Kaibab National Forest. The severest defoliation was about 2 miles west of Jacob Lake, Ariz., where 2,688 acres were heavily defoliated and 2,432 acres were moderately defoliated. Evidence of larval feeding was also noted on several thousand additional acres.

While many stands were completely defoliated, most trees were expected to recover. A few low-vigor trees are expected to die from defoliation or from secondary bark beetle attacks.

Status of Diseases

Dwarf mistletoes, *Arceuthobium* spp. Southwestern dwarf mistletoe, *A. vaginatum* subsp. *cryptopodum* (Engelm.) Hawks. and Wiens, continued to be the most important disease of ponderosa pine in Region 3. Losses caused by this disease, in terms of both growth and reduction and mortality, have been estimated to exceed 18 million merchantable cubic feet a year in the Southwest. Surveys conducted this year on approximately 3,100 acres of mistletoe-infected ponderosa pine on four Ranger Districts were used as data for the RMYLD simulated yield program. Results of the simulation runs were used by Ranger Districts to plan management activities in badly infected stands. Continued emphasis on the use of this program should eventually result in the incorporation of dwarf mistletoe management plans in all silvicultural activities in infected stands.

A mistletoe control project to kill infested overstory trees ir plantations was started on the Tusayan Ranger District, Kaibab National Forest, Ariz. The few, badly infected overstory trees were poisoned by a silvicide, creating snag trees for wildlife use. Approximately 30 percent of the 1,800 acres have been treated this past year.

Researchers from the University of Arizona discovered a population of fir mistletoe *(Arceuthobium abietinum* f. sp. *abietinum)* on white fir in Marshall Gulch, in the Santa Catalina Mountains, Coronado National Forest, Ariz. This is only the second known location for the mistletoe in southern Arizona (it occurs in one small area in the Chiricahua Mountains). The next closest known occurrence is at Grand Canyon National Park, nearly 250 miles north.

A cooperative project was established between Region 3, Rocky Mountain Forest and Range Experiment Station, and the University of Arizona to gather badly needed information on Douglas-fir dwarf mistletoe, *Arceuthobium douglasii* Engelm. Data on the incidence and growth of mistletoe-infected and uninfected Douglas-fir were taken on 150 plots in the White Mountains of Arizona. The project will continue in 1980 in New Mexico.

Root diseases. A complex of *Heterobasidion annosum* (Fr.) Bref. (=*Fomes annosus* (Fr.) Cke) and *Armillariella mellea* (Vahl. ex Fr.) Karst. caused mortality in corkbark fir on the Apache-Sitgreaves National Forest, Ariz. The complex appeared to kill trees with basal and root wounds 5 to 10 years after wounding. Both pathogens spread between trees via root contacts.

Seedlings were reported killed by charcoal root rot, *Macrophomina phaseoli* (Maubl.) Ashby, from the Lincoln National Forest, N. Mex., and the Tonto and Kaibab National

Table 4. — *Population trend of spruce budworm for treated and untreated areas in project area of the Jemez Mountains, Santa Fe National Forest, N. Mex.*

	1977		1978		1979			
	Prespray		Postspray					
	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated
Number of larvae per 100 buds	14.9	12.4	1.0	6.9	0.9	8.7	0.8	8.9
Number of egg masses per square meter			1.7	9.9	0.4	10.1	0.6	15.8

Other insects (R-3)

Insect	Host	Location	Remarks
Arizona five-spined ips *Ips lecontei* Sw.	Ponderosa pine	Arizona	Populations decreased for a second year.
Aspen leaftier *Sciaphila duplex* (Walsing.)	Aspen	Santa Fe National Forest, N. Mex.	30 to 50 acres affected.
Cedar bark beetle *Phloeosinus* sp.	Juniper	Jicarilla Apache Indian Reservation, N. Mex.	
Engraver beetles *Ips* spp.	Ponderosa pine and spruce	Apache-Sitgreaves National Forest, Ariz.	Second year of defoliation, around campground areas.
Fruit tree leaf roller *Archips argyrospilus* (Walk.)	Chokecherry	Carson National Forest, N. Mex.	Second year of defoliation, around campground areas.
Pine seed chalcid *Megastigmus albifrons* Walk.	Ponderosa pine	Kaibab and Coconino National Forests, Ariz.	
Pinyon needle scale *Matsucoccus acalyptus* Herb.	Pinyon pine	Gila, Lincoln, and Santa Fe National Forests, N. Mex.	Scattered.
Ponderosa pine cone beetle *Conophthorus ponderosae* Hopk.	Ponderosa pine	New Mexico and Arizona	Throughout both States, with heavy cone losses in localized areas.
Ponderosa pine seed moth *Laspeyresia piperana* (Kear.)	Ponderosa pine	New Mexico and Arizona	Scattered throughout both States.
Red turpentine beetle *Dendroctonus valens* LeC.	Ponderosa pine	Kaibab National Forest, Ariz. and Carson National Forest, N. Mex.	Scattered.
Roundheaded pine beetle *Dendroctonus adjunctus* Blandf.	Ponderosa pine	New Mexico and Arizona	Scattered, with incidental tree losses.
Scarab beetle (a) *Phyllophaga* sp.	Ponderosa pine	T-Bar Grasslands and Gila National Forest, N. Mex.	Infestation reported in 1978 collapsed.
Southwestern pine tip moth *Rhyacionia neomexicana* (Dyar.)	Ponderosa pine	Apache-Sitgreaves National Forest, Ariz.	

Forests, Ariz. This disease, a serious pathogen of pine species in nurseries, caused only small losses in outplantings.

Researchers from New Mexico State University confirmed the presence of black stain root disease, *Verticicladiella* spp., in beetle-killed ponderosa pine on the Lincoln National Forest, N. Mex. The fungus was isolated from stain in the roots, from beetle galleries, and from adult insects(*Hylurgops* spp.). This disease was also found on several dead ponderosa pine on the Prescott National Forest, Arizona.

Aspen diseases. Aspen shoot blight, *Napicladium tremulae* (Frank) Sacc., caused some defoliation in aspen stands in many areas of Region 3. Larger than average amounts of spring moisture contributed to the seriousness of the disease. Stands on the Carson, Cibola, Gila, and Lincoln National Forests, N. Mex., as well as the Coronado National Forest, Ariz., suffered some minor growth loss and mortality from the disease.

Final year data were taken on a cooperative study(Region 3, Region 2, and RM Station) evaluating diseases of aspen in trees remaining after logging. Data were taken on all trees on 11 study plots in New Mexico and Colorado. The most common canker found on trees was caused by *Ceratocystis fimbriata* Ell. & Halst.

Abiotic diseases. Special environmental conditions during an unusually cold and snowy winter in 1978-79 caused widespread winter damage to several species of conifers in northern Arizona and New Mexico. Species affected included ponderosa pine, pinyon pine, and juniper. Hardest hit were the junipers, which showed some mor-

Other diseases (R-3)

Disease	Host	Location	Remarks
Fir broom rust *Melampsorella caryophyllacearum* Schroet	White fir and cork fir	Arizona and New Mexico	Found throughout mixed conifer forest type. Caused some top-kill and breakage due to bole infections. No estimate of volume lost.
Ink spot leaf blight *Ciborinia* sp.	Aspen	Coronado National Forest, Ariz.; Carson and Cibola National Forests, N. Mex.	Scattered in aspen stands; some defoliation and associated growth loss.
Limb rust *Peridermium filamentosum* Pk.	Ponderosa pine	Arizona and New Mexico	Caused branch and some tree dieback mortality. Important on seed trees and in cone collecting areas.
Spruce broom rust *Chrysomyxa arctostaphyli* Diet.	Engelmann and blue spruce	Arizona and New Mexico	Common in some areas of mixed conifer. Causes some top-kill and dieback.
Indian paint fungus *Echinodontium tinctorium* (E. & E.) E. & E.	White fir	Arizona and New Mexico	Frequent on overmature white fir. Large but unknown amounts of loss due to cull.
White heart rot (a) *Inonotus dryophilus* Pers. ex Fr. *(Polyporus dryophilus)*	Gambel oak	Arizona and New Mexico	Distributed on all Forests.
White heart rot (b) *Phellinus weirianus* Murr.	Arizona walnut	Coronado and Tonto National Forests, Ariz.	Serious decay of walnut in campgrounds.

tality in certain areas of the Kaibab and Coconino National Forests, Ariz. As expected, damage was most severe on trees located on exposed areas and marginal sites. Damage to the pines consisted of dieback of needles and smaller branches, and some mortality in seedlings.

Rocky Mountain Forest and Range Experiment Station reported that aerial shoots of oak mistletoe (*Phoradendron villosum* subsp. *coryae*) in the Fort Apache Reservation, Ariz., were severely damaged by cold. All plants examined in the vicinity of Whiteriver, Fort Apache, and Cedar Creek had dead shoots. It is not known if the root system of the mistletoe within the oak branches was also killed, so observations will be made later to see if the mistletoe resprouts. The desert mistletoe (*P. californicum*) in the Salt River Canyon on Highway 60 was similarly damaged. The juniper mistletoe (*P. juniperinum*) occurs in the same area as the oak mistletoe on the Fort Apache Reservation. This mistletoe is known to be quite frost-hardy and it was not affected. The damage was apparently associated with abnormally cold weather in early December 1978, when a minimum of -2° F (-18.9° C) was recorded on December 9, at Whiteriver, Ariz.

Because of the large amount of moisture in the previous winter and this spring, drought was not a problem in the Region in 1979; however, lack of moisture during June, July, and August caused mortality in some seedling plantations.

Nursery diseases and mycorrhizae. Damping-off, caused by *Fusarium* spp., was responsible for minor losses in newly emerged ponderosa pine seedlings at the Albuquerque Tree Nursery. Losses occurred during May and June, much earlier than is normally expected, but did not exceed 1 percent of the seedlings in the section sustaining the heaviest losses. Heavy irrigation, necessary to soften the soil so that seedlings could emerge, probably allowed the fungus to develop.

Soil samples from nursery seedbeds to be sown in the spring of 1979 were tested for population levels of *Fusarium* spp. and *Pythium* spp., both before and after fumigation. Results obtained from these samples, and from samples taken from areas to be sown in 1980, will be used to monitor the effectiveness of fumigation techniques at the Nursery.

An evaluation of seedlings taken from test beds inoculated with the mycorrhizal fungus *Pisolithus tinctorius* (Pers.) Cooper and Couch indicated that so few roots (less than 1 percent) were infected that the study was terminated. High soil pH was the probable reason for the lack of mycorrhizal formation. This study was part of a nationwide nursery evaluation of *P. tinctorius* conducted in cooperation with the Mycorrhizal Institute in Athens, Ga.

Animal damage. Severe bear-caused damage to corkbark fir was observed on the Apache-Sitgreaves National Forest, Ariz. In one stand, 50 percent of the dead firs had been girdled and killed by bears.

Rodents girdled seedlings in several plantations on the Lincoln National Forest, N. Mex., and the Kaibab and Tonto National Forests, Ariz.

Intermountain Region (R-4)[1]

Forest Insect and Disease Management Staff
State and Private Forestry
Ogden, Utah

Conditions in Brief

Lodgepole pine mortality increased dramatically in the Intermountain Region where an estimated 5,435,000 trees were lost to mountain pine beetle. Ninety-six percent of these losses occurred on the Targhee National Forest in Idaho and Wyoming. This represents a considerable increase over the lodgepole mortality recorded in 1978. Chronic infestations continued to kill lodgepole and ponderosa pine in and adjacent to the village of McCall, Idaho, and southward along the north fork of the Payette River to Smiths Ferry, Idaho.

Douglas-fir mortality remained static in the Intermountain Region with an estimated 15,600 trees killed. An increase developed in Grand Teton National Park, Wyo., and decreases were noted on the Boise and Salmon National Forests, Idaho.

Defoliation by western spruce budworm expanded by 244,000 acres in 1979 to 1,272,700 acres exclusive of the Idaho Primitive Area. Expansions also occurred on the Salmon, Targhee, and Boise National Forests, Idaho, and Grand Teton National Park. Decreases were noted on the Bridger-Teton National Forest, Wyo., and Payette National Forest, Idaho.

Results of a dwarf mistletoe survey quantified incidence and impact caused by the pathogen on 15 of the 16 National Forests in the Intermountain Region. Winter injury was prominent, mainly on seedlings and saplings, to both individual trees and forest stands on the Payette, Boise, and Sawtooth National Forests, Idaho.

[1]Includes forests in Utah, Nevada, southern Idaho, western Wyoming, and eastern California.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. Mountain pine beetle activity increased dramatically on the Targhee National Forest in Idaho and Wyoming, but decreased in other areas of the Intermountains Region. Total tree mortality from mountain pine beetle was estimated at 5,435,000.

The Targhee National Forest, which has a history of massive mountain pine beetle outbreaks, was once again the scene of heavy buildups along the western slopes of the Teton mountain range from the southern boundary of Yellowstone Park southward to the Victor-Jackson Hole Highway. This area was beset with heavy lodgepole mortality from mountain pine beetle 15 years ago. There was also a considerable upsurge in mountain pine beetle activity west of Driggs on the Teton Basin Ranger District in forest fringe type. Estimated lodgepole mortality on the Targhee National Forest for 1979 was 5,209,000 trees.

On the Payette National Forest in Idaho, lodgepole pine mortality attributed to the mountain pine beetle continued in the Johnson Creek-Hornet Reservoir area. Lodgepole and ponderosa pine stands in and around McCall, Idaho, continued to suffer heavy mortality. Small portions of this infestation extended onto the Payette National Forest. On the Boise National Forest, continued tree killing by mountain pine beetle occurred north and east of Deadwood Reservoir. Also, considerable mortality was recorded along the Deadwood River northward toward Deadwood Summit. Another large infestation center which expanded during the 1979 season bordered the primitive area along the North Fork of the Boise River in the vicinity of Graham airstrip. An infestation in Clear Creek, southeast of Cascade, Idaho, caused lodgepole mortality on private, State, and Federal lands where an estimated 11,000 trees were killed.

Massive infestations of mountain pine beetle on the Twin Falls District, Sawtooth National Forest, Idaho, showed a marked decrease in activity. The rapid decline of mountain pine beetle in this area started in 1977 and has dropped off to less than 2,000 trees currently infested. The mountain pine beetle caused large-scale lodgepole mortality in Warm Springs Creek and its tributaries west of Ketchum, Idaho. Also, widespread mortality was observed north of Ketchum, Idaho, along the Wood River to Galena Summit. Elsewhere, the mountain pine beetle killed thousands of lodgepole pines along the upper reaches of the south fork of the Boise River.

On the Caribou National Forest, Idaho, and Ashley National Forest, Utah, tree killing was static in some areas and increased in others. On the Ashley National Forest around Greendale Junction, infestations in ponderosa and lodgepole pine continued at a high level.

Continued infestations were noted in Alma-Taylor Hollow, Big Lake, Gull Lake, Greendale Junction, and near Browne Lake. These infestations have been chronic on the Ashley National Forest for several years. During the early and mid-fifties, epidemic populations of mountain pine beetle devastated large areas of lodgepole pine in the same area. Caribou National Forest infestations were centered north and south of Rasmussen Ridge and south of Upper Valley to Freeman Pass and in several areas west of Green Basin.

Ponderosa pines killed by the mountain pine beetle appeared in localized areas on the Boise and Payette National Forests, Idaho. A relatively new infestation of mountain pine beetle in the ponderosa pine belt on the Escalante Ranger District, Dixie National Forest in Utah is causing considerable mortality. Populations in this area are considered epidemic and increasing. As high as 49 killed trees per acre were recorded in one area.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Overall, Douglas-fir beetle activity has shown a steady decline since 1977. Total tree mortality associated with the beetle was estimated at 15,570 for the Region in 1979. An exception to the decline has occurred on the Boise National Forest in Idaho along the South Fork of the Payette River and Middle Fork of the Boise River. The large number of infestation centers previously recorded on the Salmon National Forest, Idaho, has dropped off dramatically except for areas from Dump Creek on the main Salmon River westward to the mouth of Panther Creek. Heavy group infestations at the mouth of Deer Creek and eastward along Panther Creek drainage toward Napias Creek showed a decrease in numbers of groups and trees per group. Chronic large-scale group outbreaks in Iron Creek on the Salmon National Forest have virtually disappeared.

In 1978, an upsurge of Douglas-fir beetle activity was noted on the east slopes of the Grand Teton National Park in Wyoming from Phillips Canyon northward to Moran Bay. Group sizes in 1979 have increased considerably with large-scale tree killing evident in Douglas-fir stands.

Western pine beetle, *Dendroctonus brevicomis* LeC. Mortality from western pine beetle was minimal in 1979 on both the Boise and Payette National Forests in Idaho. Only twelve mortality centers were observed during aerial detection surveys with groups averaging less than eight trees each. All mortality was concentrated on the west side of the Boise and Payette National Forests in old growth overstocked stands previously infested with western pine beetle. A few trees were observed killed by the beetle on the Escalante Ranger District, Dixie National Forest, Utah, during ground evaluations. These were associated with mountain pine beetle infestations currently in progress.

Pine engraver beetle, *Ips pini* (Say). Pine engraver infestations in Boise National Forest ponderosa pine stands showed an overall decline from 1978 levels. Mortality centers dropped from 290 in 1978 to approximately 100 in 1979. On the east side of the Forest, new outbreaks continued to increase over last year's levels with a serious infestation affecting over 3,000 trees in the Fall Creek drainage near Anderson Ranch Reservoir. Scattered groups of fading ponderosa pine also appeared in the South Fork of the Boise River north of Anderson Ranch Reservoir.

On the Payette National Forest in Idaho, *Ips* infestations continued to decline with only 200 fading trees observed from the air this year. The greatest concentration of fading trees was again observed in the area west of Council along Hornet Ridge.

Fir bark beetle, *Pseudohylesinus dispar* Blackman. This bark beetle was found killing pole and sawtimber grand fir and subalpine fir on the Payette National Forest in Idaho. Attacks along the hole were numerous with horizontal egg galleries approximately 6 to 8 centimeters in length.

Roundheaded pine beetle, *Dendroctonus adjunctus* Blandf. A survey of ponderosa pine on the Escalante Ranger District, Dixie National Forest, Utah, showed roundheaded pine beetle as one of the responsible agents causing mortality. Ponderosa from 4 to 30 inches in diameter were killed either by the beetle solely or in association with other bark beetles. Mortality of ponderosa increased approximately six times the amount recorded in 1977 and 1978. Pole and small sawtimber were the more commonly affected size classes.

Western balsam bark beetle, *Dryocoetes confusus* Swaine. Chronic mortality of subalpine fir continues to occur throughout the subalpine fir habitat types in the Intermountain Region. The western balsam bark beetle is associated with much of the mortality; however, root rots are also involved. Subalpine fir on the Ketchum Ranger District, Sawtooth National Forest, Idaho, has shown *D. confusus* and a root rot, *Fibuloporia donkii,* associated with the mortality.

Western spruce budworm, *Choristoneura occidentalis* Freeman (tables 5 and 6). Western spruce budworm activity in the Intermountain Region remained high in 1979. There was an increase of 244,000 acres defoliated over that of 1978 (1,272,700 as compared to 1,028,-700). These figures exclude defolation in the Idaho Primitive Area. Expansions of defoliation occurred on the Salmon, Targhee, and Boise National Forests, Idaho, and also Grand Teton National Park in Wyoming. Total acreage of defoliation was less in 1979 on the Bridger-Teton National Forest in Wyoming and Payette National Forest in Idaho. Two Idaho National Forests, the Challis and the Caribou, also showed evidence of budworm defoliation.

The Salmon National Forest showed the greatest increase in budworm activity. In 1978, 183,200 acres were defoliated and by 1979 this figure increased to 344,600 acres, an increase of 88 percent. This upsurge is especially heavy on the North Fork Ranger District.

On the Targhee National Forest, increases were also noted. In 1978, 105,800 acres were defoliated and by 1979 there were 206,700 acres, an increase of 95 percent. This was due to intensification in old areas and new outbreaks located on the East Division as follows— in the north fork of Indian Creek, in Blowout Canyon, and 3 miles east of Victor, Idaho, in Game Creek.

On the Boise National Forest, defoliation increased by 30,000 acres (1978: 228,000; 1979: 258,000). There was a decrease in the number of acres defoliated 1 mile north of Deadwood Reservoir, but this was more than compensated for by new outbreaks and an increase of acreage in already infested areas.

New outbreaks were located 7 miles north of Deadwood Reservoir, along both sides of Canyon Creek from Fox Creek northeast to within 2 miles of Bull Trout Lake, and a few small outbreaks near Monumental Peak and Eureka Point.

On the Grand Teton National Park in Wyoming, there was an increase of 9,300 acres defoliated by the budworm. This defoliation was classed as light to moderate and was located

on the west side of the park around Phelps Lake extending to Jenny Lake; a new area was seen extending along the western side of Jackson Lake. Heavy defoliation continues on Blacktail Butte.

On the Payette National Forest, a decrease in defoliation of 5,000 acres was recorded. There were a few new outbreaks, whereas some older areas decreased in size.

On the Bridger-Teton National Forest there was a decrease in activity and defoliation even though there were a few new outbreaks southwest and northeast of Phelps Lake; overall the areas of defoliation have consolidated and decreased in intensity.

Defoliation on the Payette and Boise National Forests, which was predominately moderate to heavy in 1979, is predicted to be light to moderate in 1980. These predictions are based on egg mass counts made during September 1979 (table 6).

Larch casebearer, *Coleophora laricella* (Hubner). Defoliation by larch casebearer was detected in the Elkhorn Creek drainage on the Payette National Forest, Idaho, in 1978; this infestation persisted in 1979.

Another larch casebearer infestation of approximately 110 acres was detected in 1979 on the Boise National Forest, Idaho, in the Van Wyck Creek drainage on the west side of Cascade Reservoir.

F-702374

Western larch defoliated by the larch casebearer, Coleophora laricella, *on the Payette National Forest, Idaho.*

F-702375

Western spruce budworm, Choristoneura occidentalis, *infestation on the Boise National Forest, Idaho.*

Ponderosa pine needle miner, *Coleotechnites* sp. This needle miner was active on approximately 1,060 acres of the Salmon National Forest, Idaho, in Lick Creek and Powder Gulch drainages of the North Fork Ranger District. Needle miner activity was also detected on the Boise National Forest in Idaho on the Emmett Ranger District in the Second Fork, Fir Gulch, and Pine Creek drainages. This infestation covered approximately 1,600 acres.

Status of Diseases

Dwarf mistletoes, *Arceuthobium* spp. Surveys were conducted on 182 miles of roadside on the Challis National Forest in Idaho and on 246 miles of roadside on the Dixie National Forest in Utah. The objectives were to assess the incidence of and cubic-foot growth reduction caused by lodgepole pine dwarf mistletoe (*Arceuthobium americanum* Nutt. ex Engelm.) and ponderosa pine dwarf mistletoes (*A. campylopodum* Engelm. and *A. vaginatum* subsp. *cryptopodum* (Engelm.) Hawks, and Weins). Incidence of dwarf mistletoe from the roadside surveys conducted in 1978 and 1979 is summarized in table 7.

Growth reduction estimates were made on lodgepole pine stands by running the plot data through the RMYLD yield simulation program. To make the Forest figures comparable, the annual cubic-foot reduction was divided by the acres of lodgepole pine type on each Forest (table 8).

Douglas-fir stands were also surveyed for dwarf mistletoe (*Arceuthobium douglasii* Engelm.) in anticipation of future analysis with proposed Douglas-fir yield simulation models. The survey consisted of both a roadside rating and detailed plot inspections.

Forest Insect and Disease Management funding was provided to three National Forests in 1979 for dwarf mistletoe control projects. About 12,000 acres of regenerated stands were protected from future dwarf mistletoe infections through sanitation and overstory removal projects. These include:

11,050 acres on the Targhee National Forest, Idaho

510 acres on the Payette National Forest, Idaho

400 acres on the Caribou National Forest, Idaho.

An additional 10,000 acres of older clearcuts were presuppression surveyed on the Targhee National Forest to stratify areas for future dwarf mistletoe control projects.

Douglas-fir mortality survey. A contract survey between Forest Insect and Disease Management and the University of Idaho was conducted in the Featherville, Idaho, area on the Boise and Sawtooth National Forests. An estimated 10 percent of the trees, mostly in discrete centers, had died within the last 5 years. Mortality was previously attributed to Douglas-fir beetle. Preliminary survey results suggested that four "systems" of diseases and insects were operating individually or in conjunction in the Douglas-fir mortality areas. Root disease infection appeared to initiate tree decline in all cases. Frequently isolated root disease fungi included *Phaeolus (Polyporus) schweinitzii* (Fr.) Pat., *Poria (Perenniporia) subacida* (Peck) Sacc., *Inonotus (Polporus) tomentosus* (Fr.) Gilbertson, and several species of *Verticicladiella*. Insects identified on root-diseased trees included *Pseudohylesinus nebulosus* (LeConte), *Dendroctonus pseudotsugae* Hopkins, *Hylastes* spp., and *Scolytus tsugae* (Swaine).

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor. No confirmed cases of this disease were reported in Utah or Nevada. In southern Idaho the disease continued to take a toll of elms in communities without control programs. Losses in the city of Boise, Idaho, were held to six trees, mainly because of an aggressive Dutch elm disease control program.

Winter injury. Winter burn was severe on individual seedling and sapling ponderosa pine on the Payette National Forest in Idaho. Injured trees were generally open-grown or on the south side of stands near roadcuts. Most recovered by the fall of 1979.

Table 7. — *Incidence of lodgepole pine, ponderosa pine, and Douglas-fir dwarf mistletoes on 15 National Forests in the Intermountain Region, 1978-79*

National Forest	Species infected		
	Lodgepole pine Percent	Ponderosa pine Percent	Douglas-fir Percent
Ashley	58	8	21
Boise	57	[1] *	78
Bridger-Teton	67	—	17
Caribou	68	—	21
Challis	70	—	40
Dixie	[2]—	10	89
Fishlake	—	66	24
Manti-LaSal	—	34	*
Payette	50	*	80
Salmon	59	*	49
Sawtooth	71	*	53
Targhee	79	—	55
Toiyabe	17	35	25
Uinta	28	—	—
Wasatch	34	—	9

[1]Category needs further investigation.
[2]Little or none of this species occurs on the Forest.

Table 5. — *Western spruce budworm defoliation in the Intermountain Region, 1979*

Forest	Light	Moderate	Heavy	Total(1979)	Total(1978)	Difference
Boise	44,800	36,100	66,500	258,000	228,000	+ 30,000
Payette	46,400	52,900	176,200	303,900	308,900	− 5,000
Targhee	38,900	79,000	88,800	206,700	105,800	+100,900
Salmon	91,800	99,800	153,000	344,600	183,200	+161,400
Bridger-Teton	38,300	73,900	34,800	147,000	199,600	− 52,600
Grand Teton	7,100	3,600	1,800	12,500	3,200	+ 9,300
Totals	267,300	345,300	521,100	[1]1,272,700	1,028,700	[1] +244,000

[1]Primitive Area defoliation not included.

Table 6. — *Western spruce budworm egg mass survey in the Intermountain Region, 1978-1979*

Forest	1978 egg mass counts, average/cluster	1978 prediction (damage category)	1979 egg mass counts, average/cluster	1980 prediction (damage category)
Boise-Payette National Forest				
Unit 60(Cascade)	12.1	Heavy	4.5	Moderate
Bridger-Teton National Forest				
Unit 3	46.3	(Very)Heavy	21.4	Heavy
Caribou National Forest				
Unit 6 (Alpine Junction)	not done		13.8	Heavy
Grand Teton National Park	20.3	Heavy	not done	
Payette National Forest				
Unit 10 (New Meadows)	5.2	Moderate	2.4	Light
Unit 20 (Brundage)	7.5	Heavy	4.8	Moderate
Unit 30 (Council)	13.6	Heavy	5.3	Moderate
Unit 40 (East McCall)	9.7	Heavy	7.6	Heavy
Unit 50 (South Fork)	4.4	Moderate	2.2	Light
Salmon National Forest				
Unit 04 (Cobalt)	8.5	Heavy	16.1	Heavy
Unit 80 (North Fork)	38.2	(Very)Heavy	22.8	Heavy
Targhee National Forest				
Unit 1 (West Division)	23.7	Heavy	25.8	(Very)Heavy
Unit 2 (East Division)	5.5	Moderate	6.1	Moderate
Unit 5 (Driggs or South Division)	14.6	Heavy	21.2	Heavy

Winter drying also affected grand fir saplings in mountain valleys in and around the Boise National Forest in Idaho. The soil was still frozen 6 inches below the surface in early May.

About 1,800 acres of Douglas-fir in and adjacent to the Baldy Mountain ski complex on the Sawtooth National Forest in Idaho were affected by winter injury. Foliage mortality occurred both uniformly on the same sides of all trees in a stand or in a mottled pattern. The affected trees are expected to recover. Both winter burn and drying resulted from the combination of abnormally cold temperature and less-than-average insulating snowpack that occurred in the area during the winter of 1978.

Table 8. — *Incidence of dwarf mistletoe in lodgepole pine and the estimated growth reduction for nine National Forests in the Intermountain Region*[1]

National Forest[2]	Number of plots established within lodgepole pine type	Percent of lodgepole pine plots with dwarf mistletoe	Annual cubic-foot volume loss due to dwarf mistletoe	Annual cubic-foot volume loss per acre of lodgepole pine type
Ashley	31	58	3,304,455	7.6
Boise	17	57	1,598,052	6.7
Bridger-Teton	30	67	3,491,856	7.9
Caribou	19	68	2,290,318	7.3
Payette[3]	6	50	1,460,868	7.7
Salmon	34	59	4,965,080	11.1
Sawtooth[4]	7	71	3,798,757	21.6
Targhee	58	79	6,066,900	7.2
Wasatch	41	34	1,600,066	3.9

[1]Based on 1978 roadside survey information and computations from the RMYLD simulation model.
[2]Humboldt, Toiyabe, Fishlake, Dixie, Manti-LaSal, and Uinta National Forests have little or no lodgepole pine type. The Challis National Forest was not completed.
[3]Few plots were established because of relatively little lodgepole pine type.
[4]From Burley and Twin Falls Districts only.

Pacific Southwest Region (R-5)[1]

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Conditions in Brief

In northern California, tree mortality resulting from a combination of drought (1975-1977), bark beetles, other insects, and diseases was substantially less than that in the previous few years (table 9). Table 10 summarizes tree mortality by causal agent.

The rate of decline in activity of the western pine beetle that began in late 1978 accelerated in 1979 so that by year's end, only scattered ponderosa pine mortality could be found in areas other than Lassen County and Yosemite National Park. Scattered outbreaks of Jeffrey pine beetle and mountain pine beetle caused some concern to resource managers in the eastside pine type of northeastern California. The continued Statewide mortality of large sugar pine caused by the mountain pine beetle indicated that these trees had not recovered from the drought as have other tree species. Top killing and tree mortality in red and white fir was scattered and widespread. Several diseases and insects, including the fir engraver and roundheaded and flatheaded borers, were implicated, but populations of these insects also seemed to be declining by October 1979.

The lodgepole needle miner persisted in Yosemite National Park as did the fruit tree leafroller in San Bernardino County. A new infestation of pandora moth caused serious injury to Jeffrey pine in Mono County.

Table 9. — *Tree mortality on 6.3 million acres of commercial forest land in the 12 National Forests of northern California - 1975 to 1979 (all causes)*

Time (June to June)	Number of trees killed	Board foot volume of killed trees
1975 to 1976	2.0 million	1.9 billion
1976 to 1977	4.5 million	1.2 billion
1977 to 1978	5.8 million	5.5 billion
1978 to 1979	1.1 million	1.0 billion

There were no dramatic changes in the severity or prevalence of root diseases and dwarf mistletoes; however, they continued to be the major disease problems confronting land managers. Visible injury to pines from photochemical air pollution increased noticeably in several southern Sierra Nevada locations in 1979, even though measured levels of ozone were not above those recorded in 1978.

Two diseases that are normally of minor or local importance were highly visible and widespread in California in 1979. These were Cytospora canker on true fir and Elytroderma needle disease on ponderosa and Jeffrey pine.

Fusarium root rot was the most damaging disease in both State and Federal tree nurseries. Various degrees of damage were reported for sugar pine, Douglas-fir, ponderosa pine, Jeffrey pine, white fir, and red fir.

In Hawaii, normal rainfall in 1979 broke the severe 3-year drought and relieved the stress that caused mortality in some areas. Several problems still remained — Ohia decline, eucalyptus canker, Eurasian pine aphid, and Koa moth.

Status of Insects - California

Douglas-fir tussock moth, *Orgyia pseudotsugata* (McD.). Douglas-fir tussock moth larval populations declined from 1978 population levels on monitoring plots in El Dorado County. Over 1,000 early warning pheromone traps were deployed in northern and central California in 1979; few adult males were caught, reflecting generally low population levels. One exception was an area along Highway 20 in Nevada County east of Nevada City where larvae and pupae were easily found. Trap catches were relatively high and minor feeding damage to the current year's growth was evident.

Pandora moth, *Coloradia pandora* Blake. An outbreak of pandora moth on Jeffrey pine occurred in Mono County in late May. The infestation straddled Highway 395 and encompassed Lookout Mountain and the Crestview Rest Area. A central area of about 5,000 acres was completely defoliated and nearby pockets of defoliation increased the gross area to about 10,000 acres. Feeding was completed by mid-July and the trees appeared to be refoliating. A nucleopolyhedrosis virus was confirmed from the larval population. Little defoliation is expected in the area in 1980. The moth has a 2-year life cycle and larvae will be generally absent in 1980. The pandora moth was also reported on ponderosa pine in Calaveras County and on Jeffrey pine in Tuolumne County.

Lodgepole pine needle miner, *Coleotechnites milleri* (Busck). Populations continued to defoliate lodgepole pine on approximately 100,000 forested acres in the Merced and Tuolumne River drainages in

[1] Includes forests in California and Hawaii.

Table 10. — *Total tree mortality in northern California, 12.7 million acres of commercial land — June 1978 to June 1979*

Insect/Disease	National Forest		Non-Federal		Total	
	Trees Thousands	Volume Thousand cubic feet	Trees Thousands	Volume Thousand cubic feet	Trees Thousand	Volume Thousand cubic feet
Dwarf mistletoe *Arceuthobium* sp.	233.0	38,200	154.5	8,400	387.5	46,600
Western pine beetle *Dendroctonus brevicomis*	290.5	18,300	192.5	7,400	483.0	25,700
Fir engraver *Scolytus ventralis*	105.7	7,800	70.0	1,700	175.7	9,500
Annosus root rot *Heterobasidion annosum*	17.2	4,870	11.4	1,020	28.6	5,890
Armillaria root rot *Armillariella mellea*	49.8	4,100	33.0	820	82.8	4,920
Mountain pine beetle *Dendroctonus ponderosae*	83.4	15,200	55.3	3,300	138.7	18,500
Red turpentine beetle *Dendroctonus valens*	172.0	19,600	114.0	4,200	286.0	23,800
Jeffrey pine beetle *Dendroctonus jeffreyi*	64.5	24,700	42.7	5,300	107.2	30,000
California flatheaded borer *Melanophila californica*	2.6	132	1.8	40	4.4	172
Fir flatheaded borer *Melanophila drummondi*	9.4	2,700	6.2	600	15.6	3,300
Fir roundheaded borer *Tetropium abietis*	50.7	17,000	33.6	3,600	84.3	20,600
Pine engraver beetles *Ips* spp.	2.6	6	1.8	1.3	4.4	7.3
Other disease	1.7	10	1.2	2	2.9	12
Injury	17.3	6,105	12.0	1,433	29.3	7,538
TOTAL	1,100.4	158,723	730.0	37,816.3	1,830.4	196,539.3

Yosemite National Park. The infestation spread somewhat to the east and southeast of the previously infested area and some tree mortality has again been reported from Lyell Canyon and north of Tuolumne Meadows.

Gypsy moth, *Porthetria dispar* (L.). Four adult male gypsy moths were caught in pheromone detection traps in 1979. Two moths were trapped in Santa Barbara County and one each in Los Angeles County near El Monte and in Santa Clara County near Coyote.

Silverspotted tiger moth, *Halisidota argentata* (Pack.). No 1979 tiger moth activity was reported from the Eden Valley-Elk Creek (Mendocino County) 1977 infestation area. Light activity (numerous larvae, little damage) was reported from Siskiyou County.

Tent caterpillar, *Malacosoma* sp. No caterpillar activity was reported from the bitterbrush infestation area in Inyo County that was active in the mid-1970's. Tent caterpillars on live oak were reported from San Diego County (Lyons Valley) and Mendocino County (Round Valley).

Sawflies, *Neodiprion* spp. Pine sawflies were reported on about 10 acres of ponderosa pine saplings in Shasta County and on sugar pine seedlings in a plantation in Colusa County. No reports of exceptional white fir sawfly activity were received in 1979.

Fruittree leafroller, *Archips argyrospilus* (Walk.). The fruittree leafroller infestation continued in 1979 in the Lake Gregory, Lake Arrowhead, Running Springs, and San Sevaine Ridge areas, San Bernardino County. Ornamental oaks and citrus trees were damaged near Lake Gregory, and California black oak was defoliated in the Lake Arrowhead and San Sevaine areas. In addition, a new area of infestation was reported southwest of the San Gorgonio Wilderness area, also in San Bernardino County. Defoliation

levels ranged from light (Valley of Enchantment) to moderate (Running Springs) to heavy (Miller Canyon and Frog Point). In the area surveyed, the California oakworm, *Phryganidia californica* Pack., and a tent caterpillar, *Malacosoma* sp., were associated with the leafroller.

Jeffrey pine needle miner, *Coleotechnites* sp. Population levels and feeding injury by the Jeffrey pine needle miner in the Green Valley, Big Bear City, Fawnskin, and Lake Erwin areas in San Bernardino County continuted to decline. No new areas of infestation were reported.

Western pine beetle, *Dendroctonus brevicomis* LeC. Ponderosa pine mortality caused by the western pine beetle was lower than during 1978, but still above normal. In contrast to last year, pine mortality was concentrated at higher elevations, and consequently much occurred on National Forests. Mortality caused by the western pine beetle was generally scattered throughout the Sierra Nevada with the exception of concentrations of mortality south of Stumpy Meadows Lake, El Dorado County; the State Game Refuge south of Lumberyard, Amador County; Calaveras Big Trees State Park and the adjacent communities of Arnold and Dorrington, Calaveras County; the State Game Refuge south of Dorrington and the Mather Family Camp at Groveland, Tuolumne County; and much of the Stanislaus and Sierra National Forests and Yosemite National Park in Calaveras, Tuolumne, Mariposa, Madera, and Fresno Counties.

In situations where scattered and concentrated ponderosa pine mortality occurred, overstocking, dwarf mistletoe, and overmaturity were major factors predisposing trees to attack by western pine beetle.

Extensive ground checking in October 1979 found very few green ponderosa pine infested with western pine beetle and low numbers of dead trees still containing brood or callow adults. An exception was in Lassen County where considerable infestation remains around the Black Mountain-Patterson Mountain area. Trees that died during the late spring and summer of 1979 showed evidence of extensive woodpecker work.

Pine engraver beetles, *Ips* spp. Damage to pine by engravers was low during 1979, at about the same level of 1978. Precipitation in the

F-702376

Ponderosa pine killed by the western pine beetle, Dendroctonus brevicomis, *in Yosemite National Park, Calif.*

Sierra Nevada was about normal from October 1978 through April 1979, which may have contributed to the low levels of damage. Some killing of Coulter pine saplings occurred in southern California near Trabuco Peak in Riverside County.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. Mountain pine beetle activity in sugar pine throughout northern California continued at about the same high level seen last year. The only reported concentration of sugar pine mortality consisted of 100 trees near Countyline Road between Shasta and Trinity Counties. Factors which predisposed sugar pine to attack included overmature old-growth trees, blister rust affecting young trees in drainages, and overstocking.

Ponderosa pine mortality caused by mountain pine beetle was locally important in northeastern California. Areas of concentrated mortality were generally in overstocked pole stands, although trees of all sizes were affected. Some of the larger mortality areas were Blue Mountain, Modoc County (north of Lake Britton), Soldier Mountain, Hat Creek Rim, Shasta County; Lake Davis, Plumas County. One area where large trees were being killed was in Lassen County, generally around Poison Lake.

Lodgepole pine mortality due to the mountain pine beetle was common at higher elevations in the Sierra Nevada during 1979. Lodgepole pine commonly occurs around meadows and wet areas and the mortality may be a delayed result of the recent drought. The only concentrations of lodgepole pine mortality reported were Buck Mountain, Lassen County; and north of Antelope Lake, Plumas County.

Jeffrey pine beetle, *Dendroctonus jeffreyi* Hopk. The Jeffrey pine beetle was active throughout the Sierra Nevada and in northeastern California. The beetle killed trees at Upper Parker Creek, Modoc County; Lost Creek, Hat Creek Rim, and Thousand Lakes Wilderness, Shasta County; Chaos Crags, Raker Peak, and Butte Lake, Lassen Volcanic National Park; north of Antelope Lake and Squaw Valley Peak, Plumas County; and Portugese Pass, Tulare County. Green trees infested by the Jeffrey pine beetle during 1979 were detected in many of the mortality areas checked. Tree killing of epidemic dimension was evident in the Lost Creek area, Lassen Volcanic National Park.

Fir engraver, *Scolytus ventralis* LeC. True fir mortality and top kills were scattered throughout the mixed conifer and red fir types in northern California. Group kills of 10 or more trees were relatively uncommon but the total number of trees affected Statewide was quite large. Much of the mortality in young- and old-growth red fir was attributed solely to the fir engraver. The butts of old-growth red fir frequently were infested with only the roundheaded fir borer, *Tetropium abietis* Fall, although in some cases the tops had been attacked by the fir engraver. In some of the fir mortality that showed evidence of 1978 attacks by botn the fir engraver and the roundheaded fir borer, the fir engraver attacks were commonly aborted or showed very low brood survival.

Red turpentine beetle, *Dendroctonus valens* LeC. In contrast to 1977 and 1978, the red turpentine beetle appeared to have assumed a more typical role in the death and decline of pines this year. The red turpentine beetle was rarely found attacking pine in the absence of other beetles and attacks were usually confined to the root collar. The types of attacks seen, combined with a lower occurrence of attack by the red turpentine beetle may indicate a general increase in tree vigor following the drought. Exceptions to this condition were seen in Yosemite Valley, Yosemite National Park, and at Bass Lake, Madera County, where vigorous turpentine beetle activity continued.

Flatheaded and roundheaded borers, *Melanophila* and *Tetropium* spp. The California flatheaded borer, *M. californica* VanDyke, was seen in ponderosa pine mixed with broods of the western pine beetle and mountain pine beetle in several chronic mortality areas of Shasta County. In contrast to last year, the California flatheaded borer was a relatively minor mortality agent of ponderosa and sugar pine in most of northern California. However, in southern California, at Laguna Mountain, San Diego County, this beetle was found in nearly all dying Jeffrey pine.

The fir flatheaded borer, *Melanophila drummondi* Kby., was uncommon in true fir but was widespread in Douglas-fir in northwestern California. High levels of Douglas-fir mortality involving the fir flatheaded borer have been recognized since 1973 in Siskiyou, Trinity, and Humboldt counties. Other mortality agents, and site and stand conditions that predispose trees to mortality that have been identified in the area in past years include the Douglas-fir bark beetle, *Polyporus schweinitzii* Fr. root rot, a canker disease, dwarf mistletoe, hardwood competition, advanced tree age, and talus slopes.

The roundheaded fir borer, *Tetropium abietis* Fall, was commonly found in dead white and red firs in 1979. In white fir, the roundheaded borer was usually associated with either successful or aborted fir engraver attacks. In the lower boles of larger diameter red fir, the roundheaded fir borer was frequently the only insect infesting the tree.

Cypress bark beetle, *Phloeosinus cupressi* Hopk. This insect was found on ornamental Monterey cypress in urban park settings, often in association with cypress canker and *P. cristatus* LeC.

Insects in tree improvement areas. The black pineleaf scale, *Nuculaspis californica* (Cole.), continued to occur in large numbers on the rust resistant sugar pine at the Badger Hill Tree Breeding Arboretum. Malathion was applied during the crawler stage, but the scale population remained high.

Spider mites and grasshoppers continued to plague the efforts of tree breeders at the Chico Tree Improvement Center. An outbreak of mites during the hot weather of late summer was suppressed by treatment

with metasystox-R. When grasshoppers began to seriously damage grafted sugar and ponderosa pine, noncrop areas around transplant beds were treated with carbaryl bait (5% ai) and the transplant beds were treated with carbaryl plus oil (40% ai). Grasshoppers are expected to remain a problem in 1980.

Progeny test plantations throughout the State are now surveyed as often as possible to keep abreast of any insect and disease problems that may develop. These plantations remained free of all but scattered losses in 1979.

Cone and seed insects. Cone crops generally were poor throughout the State with the exception of sugar pine and Jeffrey pine. The sugar pine cone beetle, *Conopthorous lambertiana* Hopk., was common at scattered locations throughout the host range, but did not impede cone collection. A coneworm, *Dioryctria* sp., was infrequently found in sugar pine cones. Seedworms, *Laspeyresia* sp., were found in Jeffrey pine cones brought to the Placerville Nursery, but the loss per infested cone did not exceed seven seeds (a minor impact).

The fir coneworm, *Dioryctria abietivorella* (Grote), and the Douglas-fir cone midge, *Contarinia oregonensis* Foote, continued to cause serious losses in Douglas-fir cones at the Badger Hill Tree Breeding Arboretum and the Chico Tree Improvement Center. The fir coneworm also attacked cones of Afghanistan pine at the latter location.

Other insects (R-5)

Insect	Host	Location	Remarks
Pine butterfly *Neophasia menapia* (Felder & Felder)	Ponderosa pine	Nevada County	
Juniper twig girdler *Periploca nigra* Hodges	Juniper	San Joaquin County	Adults on cones.
Dioryctria spp.	Ponderosa pine, Monterey X knobcone pine	Calaveras County	Seedlings.
	Douglas-fir, Afghanistan pine, ponderosa pine	Butte County	Tree Improvement Center.
	Sugar pine	Placer County	Plantation seedlings.
A silkworm moth *Hyalophora* sp.	Douglas-fir	Placer County	
Ponderosa pine tip moth *Rhyacionia zozana* (Kearfott)	Ponderosa pine	Butte County	Tree Improvement Center.
Tent caterpillar *Malacosoma* sp.	Live Oak	San Diego and Mendocino Counties	
Bagworm	White fir	Modoc County	
Spiny-elm caterpillar *Nymphalis antiopa* (L.)	Elm	San Diego County	
Pine needle weevil *Scythropus* sp.	Ponderosa pine	El Dorado County	Christmas trees.
	Ponderosa pine, Jeffrey pine	Modoc County	Plantations.

Other insects (R-5) continued

Insect	Host	Location	Remarks
Twig beetles *Pityogenes* sp., *Pityopthorus* sp.	Ponderosa pine	Modoc County	
Douglas-fir engraver *Scolytus unispinosus* LeC.	Douglas-fir	Trinity and Shasta Counties	
Gall wasp *Anton douglasii* (Ashm.)	Oak	Fresno County	
Grasshoppers Acrididae	Ponderosa pine, Monterey X knobcone pine	Calaveras County	
Spittle bug *Aphrophora* sp.	Douglas-fir	Humboldt County	Nursery.
Seed corn maggot *Hylemya platura* (Meigen)	Jeffrey pine	El Dorado County	Nursery.
Giant conifer aphids *Cinara* spp.	Sugar pine, ponderosa pine, white fir	El Dorado, Trinity, Fresno, and Shasta Counties	Primarily nurseries and plantations.
European fruit scale *Lecanium corni* Bouche	Chinquapin	Siskiyou County	Causing dieback and death.
A Margarodid scale *Matsucoccus* sp.	Ponderosa pine, Jeffrey pine	Modoc County	
	Sugar pine	Calaveras County	
Pine sawfly *Neodiprion fulviceps* (Cresson) complex	Ponderosa pine	Shasta County	
Pine needle scale *Chionaspis pinifoliae* (Fitch)	Ponderosa pine, Jeffrey pine	Modoc County	
Unspecified aphids	White fir	Calaveras County	Saplings.
	Douglas-fir	Sonoma County	Christmas trees.
Wooly pine needle aphid *Schizolachus pip-radiatae* (Davidson)	Ponderosa pine, sugar pine	Siskiyou County	Plantations.
Nantucket pine tip moth *Rhyacionia frustrana* (Comstock)	Monterey pine	Orange and San Diego Counties	

Status of Insects - Hawaii

Eurasian pine aphid, *Pineus pini Koch.* Aphid populations declined sharply on Molokai and Maui, and pine plantations began to recover. A Chamaemyiid predator, *Leucopis (Neoleucopis) obscura* Hal., was introduced from France in 1976 and appeared to be responsible. It also became established on Kauai, but the aphid remained confined to its original urban infestation site and did not spread to pine plantations 23 miles away.

Eucalyptus longhorn beetle, *Phorancantha semipunctata* Fabr. Beetle activity continued despite improved growing conditions. The insect had been a significant factor in the mortality of drought-stressed *Eucalyptus robusta* and *E. saligna* in older stands planted for watershed improvement, but extensive losses have not occurred in commercial plantations.

Koa moth, *Scotorythra paludicola* (Butler). The outbreak of 1977 subsided, and stands on the infested 19,000 acres were in various stages of recovery. Subsequent mortality rose from 30 to 50 percent in young stands, top kill deformed most of the remaining trees, and efforts to produce high-quality native koa were greatly set back.

Formosan subterranean termite, *Coptotermes formosanus* Shiraki. This termite was responsible for unexpected failures of Norfolk Island pine and Australian kauri in urban areas and parks. Lack of external indicators made detection of weakened trees a major problem.

Status of Diseases - California

Dwarf mistletoes, *Arceuthobium* spp. The dwarf mistletoes were again very prevalent and damaging to all commercial conifers in California except incense-cedar. Vegetation management in many recreation areas has been overlooked in the past, and as a result, numerous campgrounds have serious dwarf mistletoe problems in both overstory and understory trees.

Annosus root disease, *Heterobasidion annosum* (Fr.) Bref. (=*Fomes annosus* (Fr.) Cke.) was again the most serious and commón root pathogen affecting all conifer species on land managed for recreation or for timber production. More than one-third of the requests for pest evaluations on National Forest land

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Dying Jeffrey pine on the margin of expanding annosus root rot center.

throughout the Pacific Southwest Region involved tree mortality caused by *F. annosus*. Although this root disease can be found in all California forest types, it was specifically identified and diagnosed as a problem on more than 23,000 acres during 1979.

White pine blister rust, *Cronartium ribicola* Fisch. and Waldh. The spring examination at a rust-resistant sugar pine test site near Happy Camp (Siskiyou County) confirmed that a substantial proportion of previously resistant pines had become infected for the first time in 15 years. These infections suggested that a new or previously unknown race of the rust may have overcome the single-gene dominant resistance of the host. Much of the rust at the test site originated in 1976; it remains to be seen whether subsequent years' infections will be more or less damaging to the pines.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor. The California Department of Food and Agriculture completed another year of surveys and aggressive sanitation to control Dutch elm disease. The disease was reported for the first time in Alameda County, bringing the total number of affected counties in the San Francisco Bay Area to eight. In 1979, 172 diseased trees were removed from these eight counties. The annual loss of elms within disease sites (1,000 foot radius around a diseased tree) is about 1 percent or less, and many of these sites have been free of disease for 3 years or more.

Cytospora canker, *Cytospora abietis* Sacc. There were unusually high occurrences of branch flagging on red and white fir in much of northern California during 1979. The flagging was caused by *C. abietis*, a canker-inducing fungus that typically intensifies within the State following periods of drought. This cankering complicated the recognition and salvage marking of high risk firs already impacted by moisture stress, the fir engraver *(Scolytus ventralis)*, dwarf mistletoe, and true mistletoe.

Elytroderma needle disease, *Elytroderma deformans* (Weir) Dark. The incidence of this needle cast was higher than normal in localized areas scattered throughout most of the range of ponderosa and Jeffrey pine. Favorable environmental conditions in the fall of 1978, especially available moisture, probably accounted for the increased infection. Although the disease was highly visible, it did not cause unusually serious damage or tree mortality.

Air pollution (Ozone). The Forest Service monitored ozone concentrations from June through October at four sites in the southern Sierra Nevada. Federal and State standards were exceeded at all locations during the summer, and daily maxima were often in the range of 10 to 14 parts per hundred million ozone, sufficient to cause observed symptoms on ponderosa and Jeffrey pines.

Twenty-seven air pollution trend plots scattered throughout the southern Sierra were evaluated for ozone injury in 1979 and compared to the level of injury in the same plots in 1977. Nineteen of these plots showed increased levels of ozone injury, six showed no change, and two had less injury. Very dramatic increases in injury at certain sites seemed partly due to abnormally poor needle retention. Many pines showing symptoms of ozone injury retained only 2 years of needles and had lost all foliage produced during the drought years of 1976 and 1977. Future recovery from drought stress in the form of increased needle retention may show a relative reduction in the amount of air pollution injury to pines in the next few years.

Nursery diseases, *Fusarium oxysporum*. (Schl.) em. Snyd. & Hans. was the most serious disease in the Federal (F) and State (S) bare-root nurseries in 1979. At the Placerville Nursery (F), where preventative treatments were the same for both years, sugar pine mortality was 12 percent in 1979 compared to 7 percent in 1978. Mortality increased in Douglas-fir as well— 2.8 percent in 1979 compared to 0.8 percent in 1978. Ponderosa and Jeffrey pine losses decreased in 1979.

At Magalia (S), *Fusarium oxysporum* killed 50 percent of the 1-0 sugar pine, 50 percent of the 1-0 white fir, and 35 percent of the 1-0 red fir. *Pythium* spp. killed about 3 percent of the ponderosa and Jeffrey pines.

Fusarium oxysporum-caused mortality was insignificant at Ben Lomond (S) and Humboldt (F) Nurseries. At Lomond, *F. oxysporum* killed 1 percent of the Douglas-fir and Scots pine, and 1 to 2 percent of the 1-0 white fir. At Humboldt, *F. oxysporum* killed scattered individual seedlings or small clusters of 5 to 15 trees, but the losses were minimal.

Diapothe lokoyae Funk (=*Phomopsis lokoyae* Hahn) caused some scattered losses of 2-0 Douglas-fir at Humboldt Nursery.

At the Chico Tree Improvement Center (F), water molds killed 20 percent of the ponderosa pine and 50 percent of the potted sugar pine stock.

Status of Diseases - Hawaii

Ohia forest decline. Rapid expansion of the decline appeared to have slowed, while the cause of the condition continued to elude investigators. The Ohia borer, *Plagithmysus bilineatus* Sharp, and the root rot fungus, *Phytophthora cinnamomi* Rands, were discounted as primary causes of the decline.

Eucalyptus canker, *Diaporthe cubensis* Bruner. This disease is known to occur only in windward Kauai, but it does pose a threat to the extensive plantations of *Eucalyptus saligna* established since 1962.

Pacific Northwest Region (R-6)[1]

Forest Insect and Disease Management Staff
State and Private Forestry
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Conditions in Brief

In 1979, losses from bark beetles decreased in Oregon and Washington to about 1,423,150 acres. Although defoliation by spruce budworm continues, there appeared to be no substantial increase in commercial forest losses.

Western spruce budworm defoliation in Washington and Oregon doubled from 0.2 million acres reported in 1978 to 0.4 million acres in 1979. The amount of defoliation on the North Cascades National Park, Okanogan National Forest, and adjacent State and private lands increased. The budworm infestation on the Warm Springs Indian Reservation in Oregon increased in size and intensity. A suppression project for control of western spruce budworm populations was carried out on 34,440 acres on the Warm Springs Indian Reservation in Oregon.

No visible Douglas-fir tussock moth defoliation was reported this year. Lower level populations were observed on the Winema National Forest in Oregon and the Wenatchee and Colville National Forests in Washington.

Mountain pine beetle continues to be the most destructive forest insect in the Pacific Northwest. Acres of infestation decreased in Oregon to 1,225,710 acres. In Washington, a slight decrease was also observed.

Elsewhere in the Pacific Northwest Region, mountain pine beetle caused heavy losses in lodgepole pine on the Deschutes, Fremont, and Winema National Forests and adjacent State and private lands in Oregon and on the Colville National Forest in Washington. In ponderosa pine type, tree mortality was observed on the Deschutes, Fremont, Ochoco, and Winema National Forests in Oregon and on the Okanogan, Wenatchee, and Colville National Forests, Colville Indian Reservation, and State and private lands north of Spokane, Wash. Mountain pine beetle losses in western white pine stands increased in Washington and decreased in Oregon in 1979. In Oregon, tree mortality was observed on the Mt. Hood, Umpqua, Deschutes, and Willamette National Forests. In Washington, tree-killing occurred on the Wenatchee, Colville, Okanogan, and Olympic National Forests, Olympic National Park, North Casade National Park, and Yakima Indian Reservation.

Scattered sugar pines were killed on the Deschutes, Willamette, Rogue River, Umpqua, and Winema National Forests and surrounding lands in Oregon. An estimated 99,800 board feet were killed by mountain pine beetles on 710 acres, a sharp decline in the losses observed in 1978.

Douglas-fir beetle activity decreased in Oregon and Washington to about 37,480 acres. Most of the tree killing occurred on the Umatilla and Wallowa-Whitman National Forests in Oregon and on the Umatilla, Okanogan, and Colville National Forests in Washington. A noted increase in activity occurred in the spruce budworm-defoliated stands in northeast Washington. Western pine beetle-caused tree mortality decreased sharply in Oregon but almost doubled in Washington. Major losses occurred on the Winema, Fremont, and Malheur National Forests in Oregon and the Yakima Indian Reservation in Washington.

Pine engraver beetle activity decreased to about 21,690 acres. The sharp decline in tree mortality is attributed to increased precipitation in the Pacific Northwest in 1978.

Winter weather injured trees in much of western Oregon and Washington. The incidence of foliage diseases was much lower in 1979 than in 1978. Root diseases increased perhaps because of certain forest management activities. Wounds created during harvesting contributed to stem decay losses.

Status of Insects

Western spruce budworm, *Choristoneura occidentalis* Free. Defoliation observed in the Pacific Northwest increased over the acreage reported in 1978. The outbreaks in the Okanogan Valley in northeast Washington continued to increase in intensity and size. The outbreak in the Methow Valley of Okanogan County and the outbreaks on the Wenatchee National Forests continued to decline since these areas were sprayed in 1977. Extent of budworm defoliation for 1979 is summarized in table 11.

Acres of defoliation on the Warm Springs Indian Reservation more than doubled this year. The Bureau of Indian Affairs, in cooperation with the U.S. Forest Service, treated 34,440 acres with carbaryl plus oil at the rate of 1 pound ai per acre during June and July. The treatment area included 5,850 acres of defoliation not visible from the air. Budworm mortality was 96 percent on treated plots in the 14-day period following treatment.

Egg mass surveys were made in the Okanogan Valley and on the Warm Springs Indian Reservation in 1979. The Okanogan survey was restricted to those areas where the biological data could aid in the selection of areas for direct operational control or used for research study in 1980. Results of these surveys indicate western spruce budworm populations in Conconully and Mt. Hull east of Oroville, Wash., are suitably high to warrant control or to meet research needs. Results of egg mass evaluations on the Warm Springs Indian Reservation indicate budworm populations may remain low following treatment in early summer.

[1]Includes forests in Oregon and Washington.

Table 11. — *Summary of western spruce budworm defoliation*[1]

Area	Acres
Washington	
Commercial forest lands	
Okanogan National Forest	157,960
Wenatchee National Forest	64,550
Other Federal	8,860
State and Private	84,760
Dedicated lands	61,940
Total Washington	378,070
Oregon	
Commercial Forest lands	
Other Federal	28,590
Total Oregon	28,590
TOTAL REGION	406,660

[1]These acreages are based on aerial survey.

Douglas-fir tussock moth, *Orgyia pseudotsugata* McD. No visible defoliation caused by this insect was detected in Oregon or Washington in 1979. Individual larvae were recovered from defoliator monitoring plots on the Winema National Forest in eastern Oregon and the Colville and Wenatchee National Forest in north-central Washington. Low-level populations continued for the ninth consecutive year at Mare's Egg Spring on the northwest side of upper Klamath Lake on the Winema National Forest.

Sawfly, *Neodiprion* sp. This insect continued to cause light defoliation of lodgepole pine on 450 acres on the Winema National Forest in Oregon. Infestations reported on the Deschutes and Umpqua National Forests in 1978 collapsed in 1979.

Larch casebearer, *Coleophora laricella* (Hbn.). Populations of larch casebearer continue to defoliate western larch stands in eastern Washington and Oregon. No formal aerial survey was made to determine the extent or intensity of defoliation in 1979; however, field observations indicate that defoliation was generally at a higher level than in 1978.

Both native and introduced parasites continue to increase in numbers. *Agathis pumila* continues to show a slow increase in numbers with very little spread from the original release sites. *Chrysocharis laricinellae,* on the other hand, is showing good population increases and spread throughout the casebearer infestation. *C. laricinellae* was found this last summer to be well distributed in the Washington Cascade population. At 4 of 5 plots sampled, *C. laricinellae* was found. Rates of parasitization ranged from 37 percent to less than 1 percent. Other introduced parasites, if established, are not numerous enough to be found in sampling. Populations of native parasites continued to increase.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. The mountain pine beetle continues as the most destructive tree killer in the Pacific Northwest. The largest outbreak is on the Malheur, Umatilla, and Wallowa-Whitman National Forests and adjacent State and private lands in northeastern Oregon. Mountain pine beetles in this area are attacking lodgepole pine and old-growth and second-growth ponderosa pine. Losses in lodgepole pine stands in 1979 are estimated at 64.1 million board feet on 418,000 acres. The mountain pine beetle is still expanding into the remaining unmanaged stands of mature lodgepole pine, the greatest losses occurring on the Dale and Ukiah Ranger Districts on the Umatilla National Forest. Tree mortality in the older outbreak areas is continuing to decline since most suitable host material has been killed. Losses in mature and immature ponderosa pine stands decreased within the outbreak area in 1979. Estimated losses of 64.9 million board feet of wood on 315,000 acres occurred this year. Greatest losses were observed in unmanaged second-growth ponderosa pine stands west of Ukiah, Oreg.

Western pine beetle, *Dendroctonus brevicomis* LeC. Western pine beetle losses in mature ponderosa pine increased in eastern Washington but decreased in Oregon in 1979. Approximately 9.5 million board feet of ponderosa pine mortality was observed on 110,800 acres in the Pacific Northwest Region. In Oregon, most of the losses occurred on the Deschutes, Fremont, Winema, Umatilla, Wallowa-Whitman, Ochoco, and Malheur National Forests; Warm Springs Indian Reservation; and adjacent State and private lands. In Washington, the majority of the losses were on the Okanogan and Wenatchee National Forests, and Yakima and Colville Indian Reservations, and adjacent State and private lands.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Douglas-fir

beetle activity declined in Oregon and Washington. The insect-killed trees totaled an estimated 8.9 million board feet on 37,480 acres. The majority of the losses, 5.6 million board feet, occurred on the Umatilla and Wallowa-Whitman National Forests, and adjacent State and private lands in eastern Oregon and Washington. Elsewhere, scattered tree mortality was observed on the Mt. Hood, Umpqua, and Willamette National Forests in western Oregon. In Washington, losses were reported on the Okanogan, Colville, Gifford Pinchot, Mt. Baker-Snoqualmie, and Olympic National Forests; the Olympic National Park; and State and private land in southwest Washington.

Ground surveys of the older outbreak areas on the Okanogan National Forest and North Cascades National Park indicate an increase in bark beetle attacks. This increase in beetle activity is attributed to poor tree vigor in stands that have sustained several years of continuous budworm defoliation. A quantitative estimate of these losses has not been made.

Pine engraver beetles, *Ips* spp. Tree mortality caused by these beetles decreased by about 94 percent in 1979. The return to normal moisture conditions is believed to have made the trees less attractive for attack. Damage occurred on approximately 21,690 acres in Oregon and Washington. Heaviest damage was reported on the Fremont, Malheur, Ochoco, Wallowa-Whitman, and Umatilla National Forests and adjacent State and private lands in Oregon, and on the Okanogan and Wenatchee National Forests in Washington.

Fir engraver, *Scolytus ventralis* Lec. Populations of this beetle decreased sharply in Oregon and increased slightly in Washington. Losses in true fir stands are estimated at 3.8 million board feet on 25,710 acres. Most damage occurred in unmanaged stands on the Fremont, Mt. Hood, Winema, Wallowa-Whitman, and Umatilla National Forests in Oregon and Okanogan, Wenatchee, and Colville National Forests in Washington.

Table 12. — *Bark beetle epidemic infestations in Oregon and Washington (R-6), 1979*[1]

Insect Species	Number	Acres	Number of trees	Infested volume (MBF)
Oregon				
Douglas-fir beetle (east-side Douglas-fir)	277	18,070	6,620	3,636.9
Douglas-fir beetle (west-side Douglas-fir)	84	3,810	1,020	1,519.6
Douglas-fir engraver	1	30	5	.3
Engelmann spruce beetle	2	90	25	6.3
Fir engraver	253	14,740	7,363	2,255.1
Flatheaded woodborer	21	990	115	6.9
Mountain pine beetle (Ponderosa pine)	1,827	362,770	380,402	66,792.4
Mountain pine beetle (Sugar pine)	21	710	125	99.8
Mountain pine beetle (White pine)	156	9,640	5,585	2,441.4
Mountain pine beetle (Lodgepole pine)	2,055	726,850	1,339,705	92,993.5
Mountain pine beetle (Whitebark pine)	5	870	630	44.1
Western pine beetle	982	89,240	10,524	8,189.0
Total Oregon	5,684	1,227,810	1,752,119	177,985.3
Washington				
Douglas-fir beetle (east-side Douglas-fir)	266	14,250	6,434	3,530.8
Douglas-fir beetle (west-side Douglas-fir)	32	1,350	235	180.8
Engelmann spruce beetle	5	600	555	138.8
Fir engraver	180	10,970	5,982	1,571.5
Flatheaded woodborer	1	50	20	1.2
Mountain pine beetle (Ponderosa pine)	483	37,810	18,799	994.4
Mountain pine beetle (Western white pine)	514	60,830	45,121	20,470.1
Mountain pine beetle (Lodgepole pine)	108	26,050	43,445	3,042.0
Mountain pine beetle (Whitebark pine)	4	180	65	4.6
Western pine beetle	277	21,560	2,457	1,351.2
Total Washington	1,870	173,650	123,113	31,285.4
Regional Totals	7,554	1,401,460	1,875,232	209,270.7

[1]Excluding pine engraver.

Other insects (R-6)

Insect	Host	Location	Remarks
Gypsy moth *Lymantria dispar* (L.)	Various hardwoods	Seattle, Wash., and Portland, Oreg.	APHIS treated 400 acres in eradication program in Seattle. Males trapped in Portland.
Flatheaded borers *Melanophila* spp.	Douglas-fir and ponderosa pine	Southwestern Oregon	Losses to this pest decreased in 1979.
Balsam woolly adelgid *Adelges piceae* (Ratzeburg)	True fir	Western Washington and Oregon	Damage observed on 2,450 acres in Washington and 360 acres in Oregon.
Western conifer seed bug *Leptoglossus occidentalis* (Heidemann)	Western white pine	Dorena Seed Orchard	Populations heavy.
Fir coneworm *Dioryctria abietivorella* (Grote)	Western white pine	Dorena Seed Orchard	Populations heavy.

Status of Diseases

Dwarf mistletoes, *Arceuthobium* spp. Douglas-fir dwarf mistletoe, *A. douglasii* Engelm., was the most serious pest of this tree species in Oregon and Washington. Forty-two percent of the host type in eastern Oregon and Washington is infected. Infected stands can be treated by clearcutting, removing infected residuals, sanitation thinning, and manipulating species.

Ponderosa pine dwarf mistletoe, *Arceuthobium campylopodum* Engelm., occurs on approximately 30 percent of the ponderosa pine type in the Pacific Northwest. The impact of this pest is slowly declining as more stands are coming under intensive management.

Root diseases. Black stain root disease, caused by *Ceratocystis wageneri* Goheen and Cobb (=*Verticicladiella wagenerii* Kendrick) was found on numerous dead and dying ponderosa and lodgepole pines in Deschutes County. This represented the first report of this disease on these two species in Oregon. Black stain was also found on Douglas-fir in several new locations in Oregon and Washington.

A major concern some Oregon and Washington forest pathologists have is an apparent increase in root disease incidence. Some of the increase can be attributed to better detection and awareness of root diseases by foresters, thereby discovering long-standing infection centers. This does not, however, explain all of the increase. Root diseases appear to be increasing as a result of forest management activities. Based upon surveys made in western Oregon, an estimated 5 percent of the Douglas-fir type is out of production because of laminated root rot (*Phellinus weirii* (Murr.) Gilb.). Locally, this can be much higher. A Forest Service evaluation of western hemlock showed that 26 percent of the trees in thinned stands contained *Heterobasidion annosum* (Fr.) Bref. (=*Fomes annosus* (Fr.) Cke.). Thirteen percent were infected in unthinned stands. Volume lost because of decay amounted to 2.2 percent in thinned and 3.4 percent in unthinned stands. Stand age ranged from 40 to 120 years. The root disease problem in true fir stands is beginning to look serious. Root rots caused by *P. weirii, H. annosum,* and *Armillariella mellea* (Vahl ex Fr.) Karst are all being found in true fir types. They are frequently found together. Most of the serious root rot infections in true firs appeared to be occurring in areas that have had repeated partial cuts.

Stem decays. A Forest Service survey of advanced white fir regeneration was made over eastern Oregon and Washington in 1979. Twenty-three stands were examined. Data from 13 stands showed 52 percent of the trees left after thinning were wounded. Decay was associated with 51 percent of the wounds. In wounded trees, 2.4 percent of the cubic foot volume was lost to decay. Much of the *Heterobasdion annosum* (Fr.) Bref. (=*Fomes annosus* (Fr.) Cke.) decay in western hemlock stands was associated with stem wounds.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor., was not reported in any additional Washington counties. Walla Walla remained the only county to have the

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Severe damage caused by armillaria root rot.

disease. There were no new findings reported in Oregon.

Foliage diseases. In general, the incidence of foliage diseases was considerably lower in 1979 than in 1978. Maple leaf blight was much less evident in 1979. Elytroderma needle blight, caused by *Elytroderma deformans* (Weir) Darker, of ponderosa pine did increase in intensity in local areas in Crook County, Oreg., and Ferry County, Wash. Swiss needlecast, caused by *Phaeocryptopus gaumanni* (Rohde) Petr., increased on Douglas-fir Christmas trees in Thurston and Mason Counties in Washington. Some Swiss needlecast was found on forest trees, but damage was negligible. Larch needlecasts, which had been prevalent in northeast Washington in 1978, were much less evident in 1979.

Winter injury. Winter drying of conifers was the most spectacular damaging agent in western Oregon and Washington in 1979. Portions of the east side were also affected. Strong winds lasting for several days, accompanied by cold temperatures and lack of snow caused many trees to lose moisture faster than it could be replaced. Affected trees suffered foliage burning and some top and branch dieback. Forest nurseries were particularly hard hit. Douglas-fir suffered the most damage. Red belt, caused by a similar phenomenon, was observed in Okanogan County, Wash. Many trees in the Portland area were severely damaged by a January ice storm.

Southern Region (R-8) and Southeastern Area[1]

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Conditions in Brief

During 1979, southern pine beetle reemerged as a major killer of trees in the Southeastern Area. Extensive losses occurred in South Carolina, Georgia, Alabama, and Mississippi. Severe late summer losses were also reported in North Carolina. Total salvage in these States will exceed 47,300,000 board feet of sawtimber plus 517,400 cords of pulpwood.

Reflecting the increase, southern pine beetle activity on National Forest lands in the these States was exceedingly high (9,300,000 board feet and 46,000 cords of the above volumes).

Despite this increase in beetle activity, Texas (scene of extensive beetle kills in the past) and Louisiana have had light beetle activity.

Introduced pine sawfly populations have increased dramatically in North Carolina and Virginia and are expected to persist at high levels.

Several geometrid hardwood defoliators were unusually active this year. Spring and fall cankerworms, linden looper, and eastern and forest tent caterpillars caused defoliation at epidemic levels.

Light or scattered damage was experienced as a result of the activities of the pine spittlebug, pine tip moth, the redheaded pine sawfly, the Virginia pine sawfly, walkingsticks, and weevils.

Cyclic activity by cicadas was high in many hardwood areas. Impact of these insects, however, is negligible.

During 1979, the balsam woolly adelgid appeared in two Fraser fir areas previously thought free of this insect. All natural stands of Fraser fir in the Tennessee to Virginia range of this species are now known to be infested.

While final data are not available, estimated losses to coneworms in seed orchards appear to exceed the $4.5 million damage incurred in 1978.

Fusiform rust continued to be a major problem in the Southeast. Recent estimates indicated that on about 3.8 million acres, at least half the trees had stem or potential stem cankers (branch cankers less than 15 inches from bole). At the same time, it was estimated that 13.8 million acres of susceptible forest type had 10 percent or more infected or potentially infected stems.

A newly reported root disease complex affecting sand pine was investigated in Florida. A loss of $250,000 in a single Florida seed orchard, plus several known disease-centers in outplanted sand pine, indicated a great potential for damage to this pine resource. A statewide survey is being made in Florida.

Live oak decline was scrutinized throughout the range of live oak. Six more Texas counties were added to the long list of affected counties in the United States. The oak wilt fungus was implicated as the cause of this problem. Further investigation is underway.

A tip blight problem was reported by several nurseries in the area. Terminal dieback and multiple terminal shoots, combined with loss of growth, were the only observable damage. Tentatively, the causal agent was determined to be a species of *Phomopsis*.

Pitch canker, while declining as a problem in plantations, is becoming a major pest in seed orchards, affecting both trees and seed.

Weather damage accounted for major losses during 1979. Snow, ice, drought, winter drying, tornados, and especially hurricanes caused serious forest tree loss in Alabama, Mississippi, Georgia, South Carolina, and Tennessee.

Decays and root rots continued to cause serious loss throughout the area.

The pine wood nematode was reported in northern Arkansas and Louisiana. The extent of mortality was not determined, but frequent reports indicated that it may be a serious problem, at least in urban environments. In addition, an undetermined species of nematode was reported associated with southern pine beetle in Alabama.

Status of Insects

Southern pine beetle, *Dendroctonus frontalis* Zimm., activity increased dramatically in South Carolina, Georgia, Alabama, and Mississippi during 1979.

In August, survey crews in Georgia reported 11,037 southern pine beetle spots, containing an estimated 148,825 cords of dead wood. By October, 243,444 cords of wood had been salvaged statewide. This total represents only about half of the estimated volume killed during the current outbreak in Georgia. Heaviest beetle activity occurred in the north-central counties and 24 counties were declared a disaster area by the governor.

The Oconee National Forest in Georgia showed some of the heaviest southern pine beetle activity in years. Between July 1 and September 30, the Oconee had salvaged 1,076,000 board feet of sawtimber and 19,027 cords of pulpwood.

In South Carolina, 1,051,000 board feet and 20,538 cords were salvaged on private land during the July-September quarter. South Carolina incurred these losses in the northwestern third of the State. In addition, the Sumter National Forest in South Carolina reported similar intense beetle activity, with 1 million board feet and 26,650 cords salvaged in fiscal year 1979.

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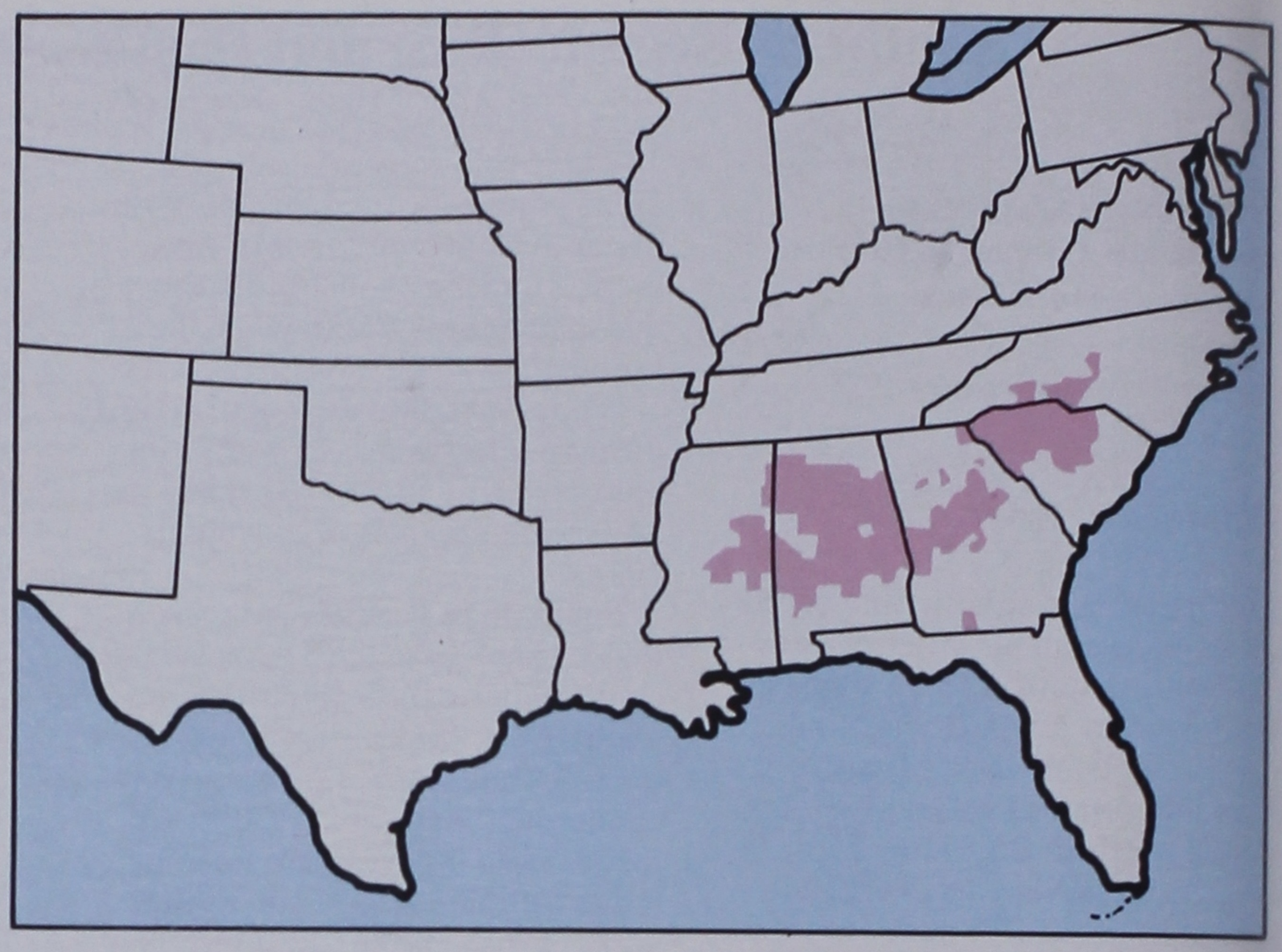
[1] Includes forests in Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

Alabama suffered serious losses to its pine resource. In all, 9,500 spots were reported during the second survey, run between August 20 and October 16, 1979. This survey, which included 47 counties, led to the detection of about 750,000 affected trees. Salvage estimates from the State are 23 million board feet, plus 304,000 cords. Value killed since July has been estimated at $15.9 million, with only $5.3 million recovered in salvage. Salvage estimates from the Alabama National Forests are 5,100,000 board feet and 10,000 cords of pine.

Mississippi also suffered serious damage caused by southern pine beetle. About 14 million board feet and 25,000 cords of pine have been infested. Surveys revealed about 6,000 spots containing a total of 346,000 trees. A net loss value of $2 million has been predicted in Mississippi after salvage operations are completed. National Forests in Mississippi have salvaged 7,200,000 board feet of pine.

North Carolina showed a surge of southern pine beetle activity in the late summer and fall of 1979. Five counties in the Piedmont area of the State qualify as "outbreak areas" (in excess of one multiple tree spot per 1,000 acres of host type). At the time of this writing, State entomologists are surveying and evaluating these and 10 other counties.

Table 13 shows host type acres infested southwide by southern pine beetle. This information is the sum of the total host type acreage within each outbreak county and has been apportioned into broad ownership classes.



Counties suffering epidemic levels of southern pine beetle (Dendroctonus frontalis) *activity.*

Table 13. — *Acres of host type in southern pine beetle outbreak counties, apportioned by ownership class, 1979*

State	All ownership	National Forest	Other public	Industrial private	Other private
Alabama	4,716,700	192,410	73,030	918,070	3,533,270
Georgia	2,824,375	167,698	140,605	602,474	1,913,598
Mississippi	1,324,200	61,620	54,610	170,370	1,037,600
North Carolina	386,349	0	896	35,647	349,806
South Carolina	3,389,702	241,869	95,787	824,314	2,227,732
Total	12,641,406	663,597	364,928	2,550,875	9,062,006

Introduced pine sawfly. Infestation by the introduced pine sawfly (*Diprion similis* Hartig), first reported in 1978, has increased dramatically in both intensity and range. The insect (previously confined to the upper Midwest and Northeast) was possibly introduced on nursery stock. The sawfly attacks all ages of white pine and now scattered infestations occur over a large area of the Southern Appalachians, from Grayson County, Va., south to McDowell County, N. C., plus an isolated occurrence in Rockingham County, Va. Lack of natural parasites and rapid reproduction (three complete generations a year) account for the insect's success. Severe defoliation and some mortality have occurred in the Linville Falls-Crossnore, N. C. area. Cocoon and parasite surveys indicate that the pest population will continue to intensify and spread.

Parasites effective in keeping the sawfly in check in its northern range are absent or very rare in the North Carolina infestation. In response to this situation, the Forest Service has initiated a pilot project to rear and release parasites obtained from Wisconsin into the infested areas in North Carolina.

Additional work on impact assessment, pheromone development, and biology have been initiated in cooperation with the Southeastern Forest Experiment Station.

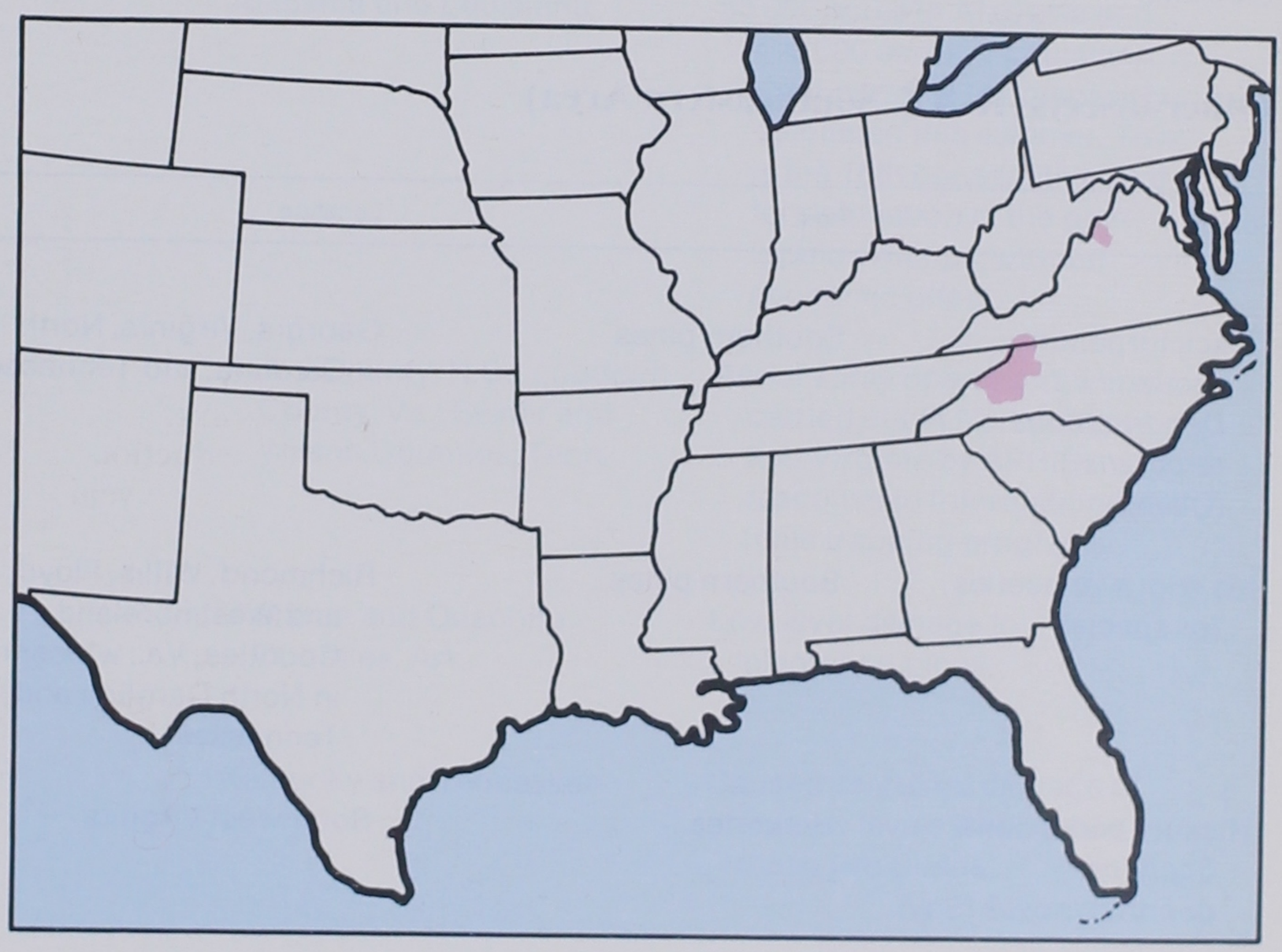
Balsam woolly adelgid. Surveys in June and September showed that the balsam woolly adelgid (*Adelges piceae* Ratz.) has become established in two fir stands on Mount Rogers, Va. This is the first confirmed report of the insect in this area, but analysis

Introduced pine sawfly larva, Diprion similis.

F-702378

of compression wood in disks taken from aphid-infested trees showed that the infestations have been established since about 1964. The host trees on Mount Rogers appear to be a hybrid Fraser fir and further verification has been proposed. All natural stands of Fraser fir from the Great Smokies National Park to Mount Rogers, Va., are now infested.

Hardwood defoliators. Geometrid defoliators, including fall cankerworm (*Alsophila pometaria* Harr.), spring cankerworm (*Paleacrita vernata* Peck), and linden looper (*Erannis tiliaria* Harr.), caused defoliation of oaks in a three-State area. Scattered areas of defoliation ranging from 2 to 700 acres in size were detected from central Kentucky, south through Tennessee and into northern Alabama. Approximately 225,000 acres of hardwood forest were affected.



Confirmed distribution of the introduced pine sawfly in the southern Appalachians.

F-702377

Fraser fir killed by the balsam woolly adelgid, Adelges piceae, *in North Carolina.*

Other insects (R-8 & Southeastern Area)

Insect	Host	Location	Remarks
Black turpentine beetle, *Dendroctonus terebrans* (Olivier)	Southern pines	Georgia, Virginia, North Carolina, and Tennessee	9,000 cords salvaged in Georgia (with *Ips*-infested timber). High activity in late summer in Virginia.
Ips engraver beetles, *Ips* species	Southern pines	Richmond, Willis, Floyd, and Westmoreland Counties, Va.; widespread in North Carolina and Tennessee	Low levels of infestation — usually associated with weakened timber.
Hickory bark beetle, *Scolytus quadrispinosus* (Say)	Hickories	Southwest Virginia	Associated with dying trees on Bryd Center State Park.

Other insects (R-8 & Southeastern Area) continued

Insect	Host	Location	Remarks
Bagworm, *Thyridopteryx ephemeraeformis* (Haworth)	Arborvitae, white pine, red cedar, and loblolly pine	Essex, Westmoreland, Isle of Wright, and Northumberland Counties, Va.; Adair County, Ky.; many scattered counties in Tennessee	Populations generally greater than 1978 in the midsouth. Serious damage (dieback of white pine terminals) in both plantations and shade trees.
Oak leaf tier, *Croesia semipurpurana* (Kearfott)	Various hardwoods	Southwest Virginia	Lowest populations in the last 10 years.
Fall webworm *Hyphantria cunea* (Drury)	Various hardwoods	Eastern Virginia; Tennessee; Franklin County, Ky.	Extremely heavy and visible defoliation in high-use scenic areas.
Eastern tent caterpillar *Malacosoma americanum* (F.)	Cherry and plum	Central Piedmont of Virginia; north-central Flordia; statewide in Kentucky	Unusually heavy in Virginia and Florida; widespread in Kentucky.
Forest tent caterpillar *Malacosoma disstria* (Hubner)	Various hardwoods	Virginia	20,000 acres defoliated in Great Dismal Swamp, Va.
		Kentucky	Light to heavy defoliation in Floyd and Estill Counties, Ky.
		Alabama and Louisiana	50,000 acres in Alabama and 400,000 acres in Louisiana were partially to completely defoliated this summer. This is the 16th consecutive year for defoliation in the gum-tupelo swamps, without economic effect.
Gypsy moth *Lymantria dispar* (Linnaeus)	Various hardwoods	Avery County, N.C.; Loudoun County, Va.; Sevier and Wilson Counties, Tenn.	Aerial spray operations were carried out in North Carolina and Virginia by APHIS in response to information from male trapping programs.
Loblolly pine sawfly *Neodiprion taeda linearis* Ross.	Southern pines	Calhoun and Ouachita Counties, Ark.	Low level damage to plantation pines.
Redheaded pine sawfly *Neodiprion lecontei* (Fitch)	Southern pines	Kentucky and Tennessee	Caused scattered damage of various levels throughout these two States.

Other insects (R-8 & Southeastern Area) continued

Insect	Host	Location	Remarks
Virginia pine sawfly *Neodiprion pratti pratti* (Dyar)	Various pines	Various locations in Virginia, North Carolina, Kentucky, and Tennessee	Damage ranged from light to severe for areas in the mid-south.
Spring cankerworm *Paleacrita vernata* (Peck)	Post oak	South and central Texas	Epidemic on 27 million acres.
Nantucket pine tip moth *Rhyacionia frustrana* (Comstock)	Shortlead and loblolly pine	North Louisiana	Heavy damage in several plantations.
	Various pines	Augusta County, Va.; Rockingham and Pasquotask Counties, N.C.; Chester, Madison, and Henderson Counties, Tenn.; scattered in Kentucky	Damage mostly light and scattered.
Variable oak leaf caterpillar *Heterocampa manteo* (Doubleday)	Various hardwoods	Carolina County, Va.; Humphreys, Stewart, Wilson, and Cumberland Counties, Tenn.	Caused up to 80 percent defoliation in Virginia; generally lighter in Tennessee.
	Oaks	Northern half of Louisiana.	Moderate defoliation.
	Oaks	Angelina, Houston, St. Augustine, Newton, and Nacogdoches Counties, Tex.	Epidemic level.
Elm leaf beetle *Pyrrhalta luteola* (Muller)	Chinese elm	Accomack County, Va.; Davidson, Dickson, Robertson, Smith, Wayne, and Van Buren Counties, Tenn.	Moderate defoliation reported.
		Arkansas, Louisiana, Mississippi, Oklahoma, and Texas	Defoliation severe in urban areas.
Locust leaf miner *Odontata dorsalis* (Thunberg)	Black locust	Northeastern Virginia, central and extreme eastern Tennessee, central Mississippi	Damage generally static to decreasing in Virginia; severe in central and east Tennessee, increasing in central Mississippi.
Walkingstick *Diapheromera femorata* (Say)	Various hardwoods	Shenandoah National Park in Va.; Ouachita National Forest, Ark.	Caused extensive heavy defoliation.
Pine leaf chermid *Pineus pinifoliae* (Fitch)	White pine and red spruce	Macon and Jackson Counties, N.C.	Caused severe shoot dieback. Also caused minor yellowing and foliage drooping of white pine in additional south-western North Carolina counties.

Other insects (R-8 & Southeastern Area) continued

Insect	Host	Location	Remarks
Pine spittlebug *Aphrophora parallela* (Say)	Various pines	Northern and eastern Virginia; statewide in North Carolina	Infestations very heavy in parts of Virginia, but impact of this insect is negligible.
Pine bark aphid *Pineus strobi* (Htg.)	White pine	Eastern Kentucky and Wythe County, Va.	Light in Kentucky, but severe in three Virginia locations.
Periodical cicada *Magicicada septendecim* (Linnaeus)	Various hardwoods	The Piedmont of Virginia, northwest Georgia, and the Piedmont of North Carolina	Widespread damage; severe on part of the Chattahoochee National Forest.
Weevils (Curculionidae)	Pines	Accomock and Augusta Counties, Va.; Putnam County, Ga. (Oconee National Forest)	Mostly secondary except for light damage on white pine in Virginia.

Previous high populations of the fall cankerworm in northern Georgia and western North Carolina have declined to low levels over most to the pest's earlier range. A 500-acre area near Fontana Lake, N. C., is the last remaining area of heavy defoliation caused by this insect.

Seed and cone insects. Southern seed orchard managers in the Coastal States from Virginia to Georgia reported heavy cone losses in early spring from attacks by the webbing coneworm, *Dioryctria disclusa* (Heinrich). On Georgia Kraft's Briar Patch Orchard near Greensboro, Ga., Barber and DeBarr (unpublished data) found losses of 25 percent on untreated trees.

Southwide in 1978, coneworm damage (all *Dioryctria* species) caused an estimated loss of 8,430 bushels of cones, valued at $4.5 million. Data for fiscal year 1979 is not available at this time; however, the loss is expected to be higher than 1978. During 1979, an average of 2 to 10 percent of the loblolly and shortleaf pine cones in Alabama, Mississippi, Louisiana, and Texas were damaged.

White pine cone beetle, *Conophthorus coniperda* (Schwarz) killed an estimated 51 percent of the white pine cone crop on the North Carolina Division of Forestry's Edwards Seed Orchard, Morganton, N. C. This loss represents 497 bushels of cones.

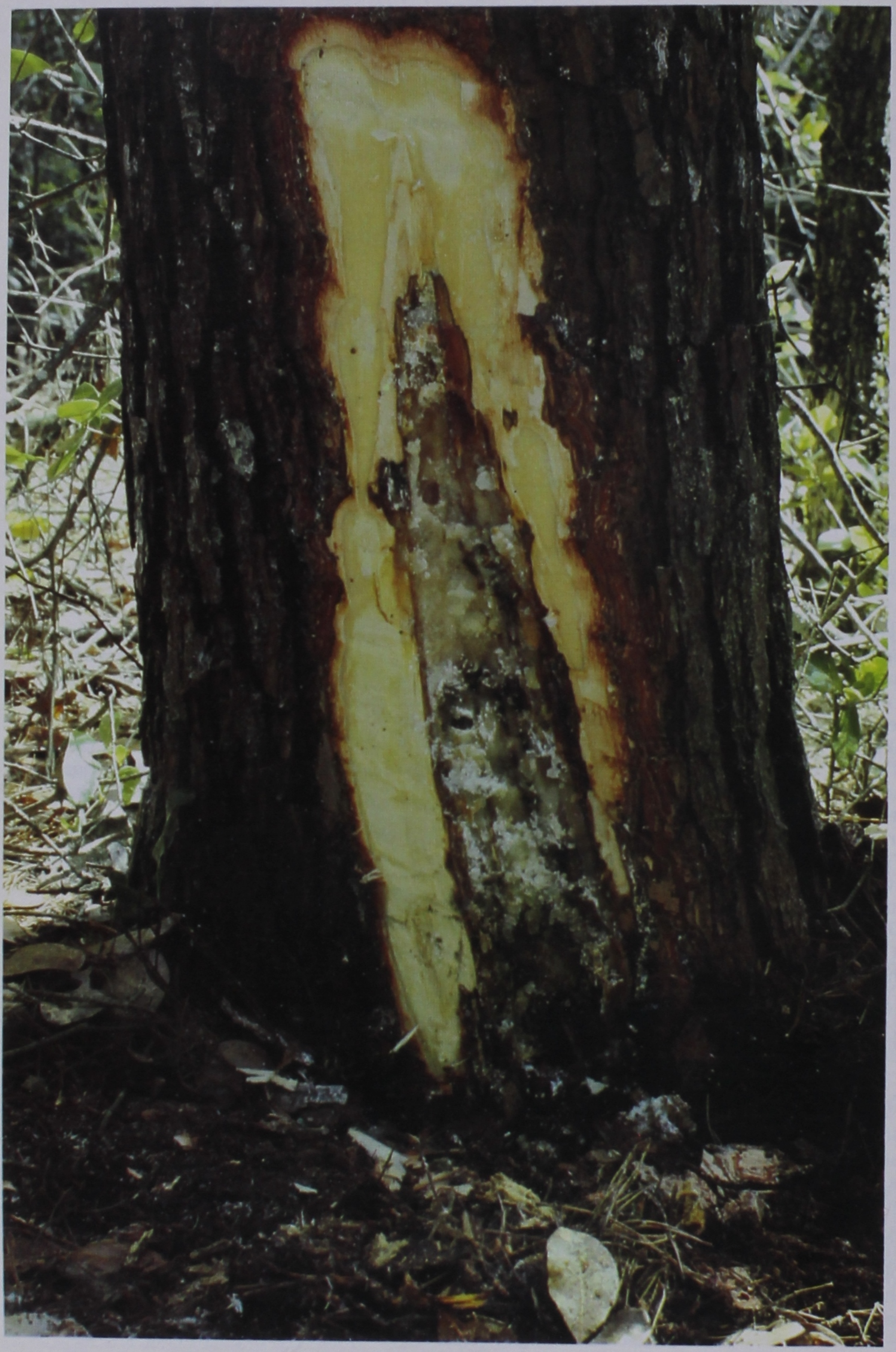
Status of Diseases

Root diseases. Annosus root disease, caused by *Heterobasidion annosum* (Fr.) Bref. (=*Fomes annosus* (Fr.) Cke.), caused an estimated 3 percent loss of the slash and loblolly pine resource. Most of this loss occurred on high hazard sites where thinning had been done. Control measures are available that could reduce losses in these areas.

Littleleaf disease (*Phytophthora cinnamomi* Rands) was the most serious disease problem of old growth shortleaf pine. Gradual growth reduction eventually resulting in premature death caused severe economic loss on several thousand acres in Georgia, South Carolina, and Alabama. During 1979, an association between littleleaf disease centers and early southern pine beetle attacks was reported. The exact impact of this association was not determined.

The exact cause of resin-soaked root disease of sand pine has not been determined. Root disease fungi found associated with this problem include *Armillariella (Clitocybe) tabescens* (Fr.) Singer, *Phaeolus (Polyporus) schweinitzii* (Fr.) Pat., *Inonotus circinatus* (Fr.) Gilbn., (*Polyporus tomentosus* var. *circenatus* (Fr.) Sart. & Maire), and *Verticicladiella procera* Kend. This disease is present throughout most of the natural and commercial ranges of sand pine in Florida and also has the potential to cause damage in Georgia and South Carolina. A survey to determine the distribution of and volume loss caused by the problem was begun, and results should be available in 1980.

Fusiform rust, caused by *Cronartium quercuum* (Berk.) Miy. ex Shirai f. sp. *fusiforme,* continued to be the most serious disease of slash and loblolly pines. The disease was most severe in a wide land corridor from central Louisiana to South



Resin-soaked wood caused by sand pine root rot.

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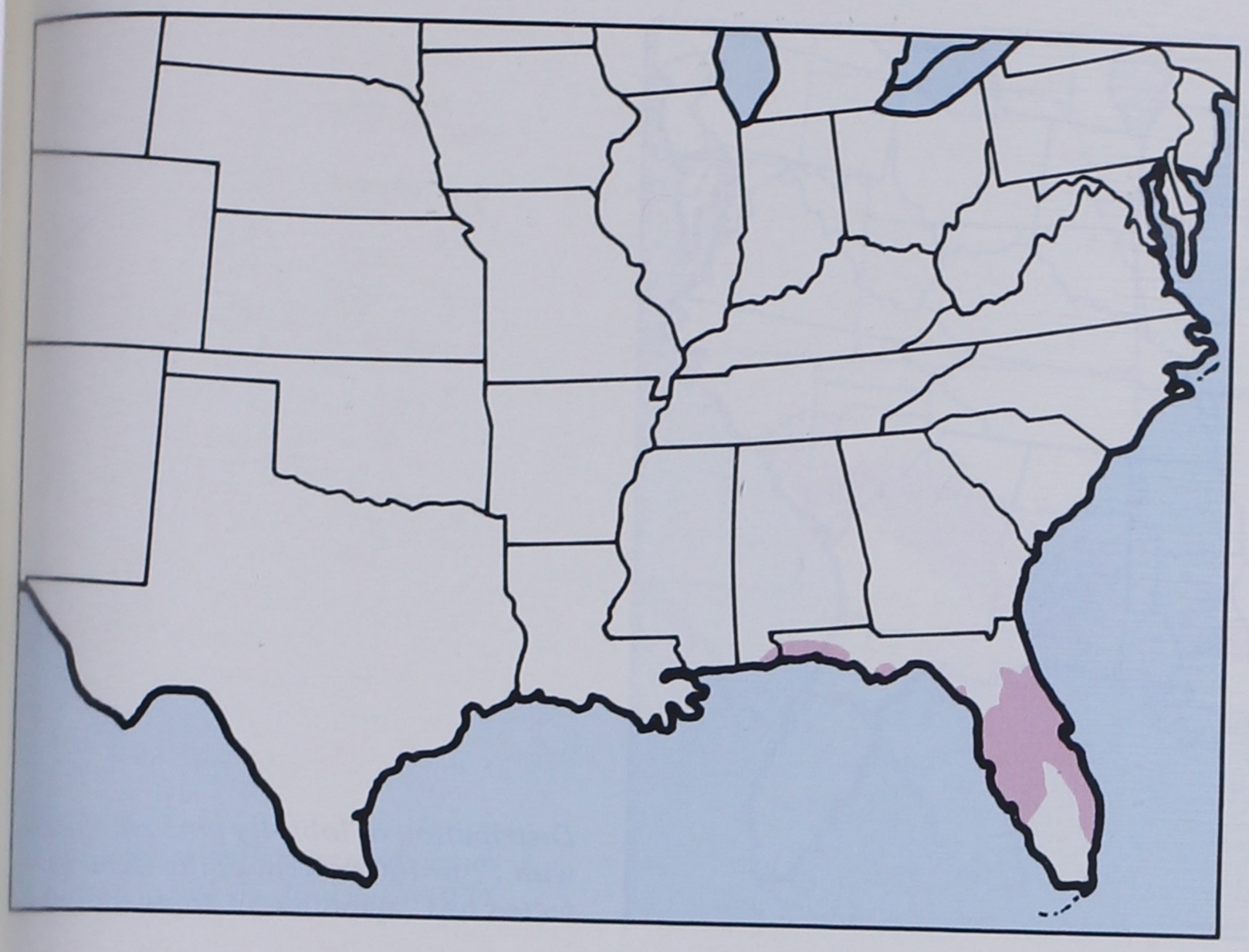
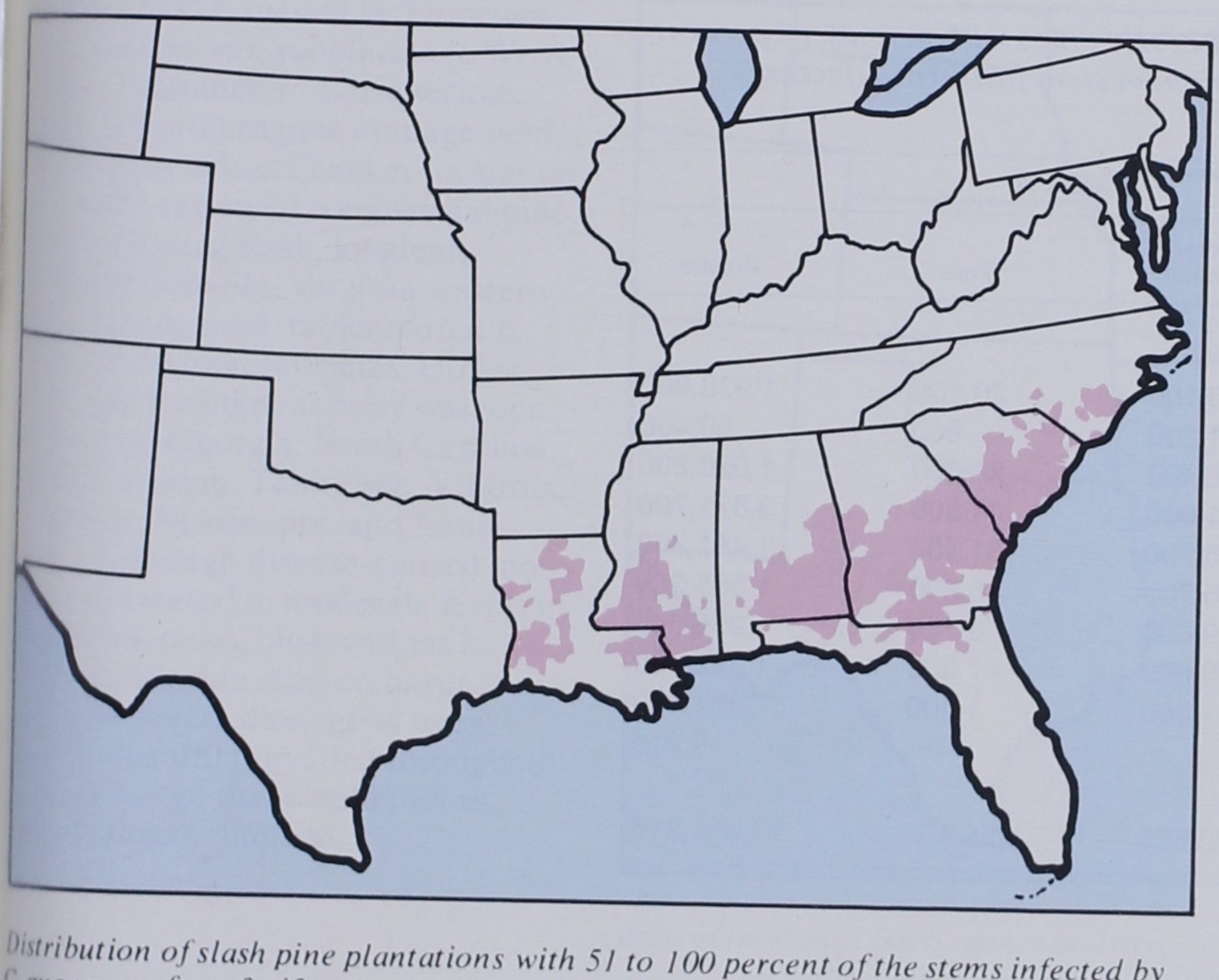


Natural range of sand pine.



Distribution of slash pine plantations with 51 to 100 percent of the stems infected by C. quercuum *f. sp.* fusiforme.

Carolina. This intensity distribution was verified in 1979 using Renewable Resources Inventory data in Georgia, Florida, North Carolina, and South Carolina.

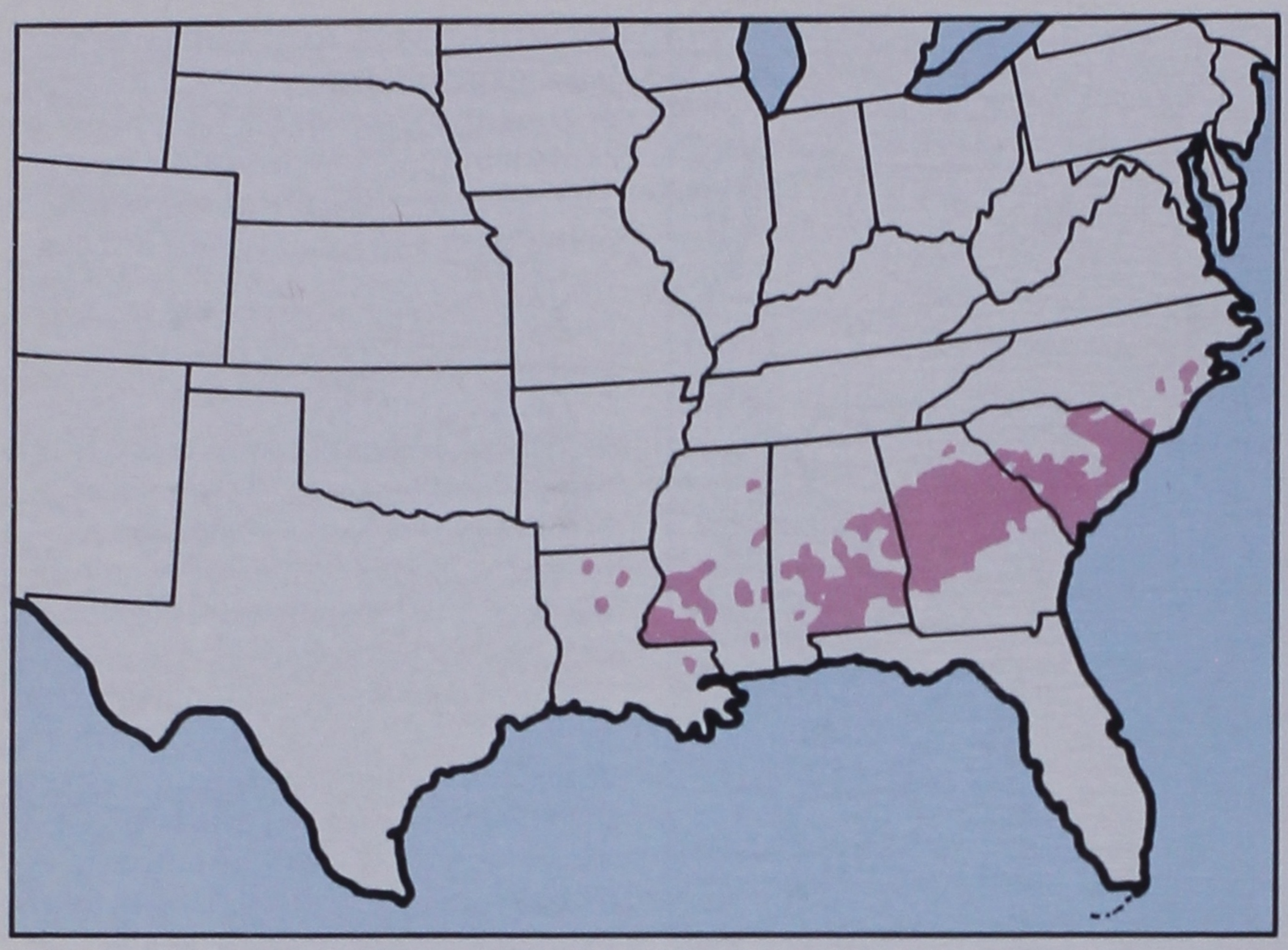
Annual losses attributed to fusiform rust were estimated at 562 million board feet of sawtimber and 194 million cubic feet of growing stock. A survey using Renewable Resources Inventory data showed there were about 3.8 million acres in the Southeastern Area that have at least 50 percent of the trees with stem or potential stem cankers (branch canker within 15 inches of the stem). The acreage with at least 10 percent of the slash and loblolly pine affected with stem or potential stem cankers was estimated to be 13.8 million (table 14).

Fusiform rust is expected to be a serious problem for many years. But, through an integrated approach of breeding for resistance, site and species selection, and close monitoring of plantations, the losses can be reduced substantially.

Brown spot disease of longleaf pine, incited by *Scirrhia acicola* (Dearn.) Sigg., caused light damage throughout the range of its host. There were only a few instances of heavy damage reported. Losses as a result of delayed break from the grass stage had not been quantified.

Wilt diseases. Oak wilt, *Ceratocystis fagacearum* (Bretz) Hunt, continued to be a disease of major concern to forest managers in Virginia, North Carolina, Tennessee, Kentucky, and South Carolina. Although there was no significant spread of the disease in these States, several new pockets of wilt were diagnosed. Moderate losses continued to occur, resulting in the maintenance of quarantine restrictions. The export of white, northern red, southern red, and cherrybark oaks was severely curtailed.

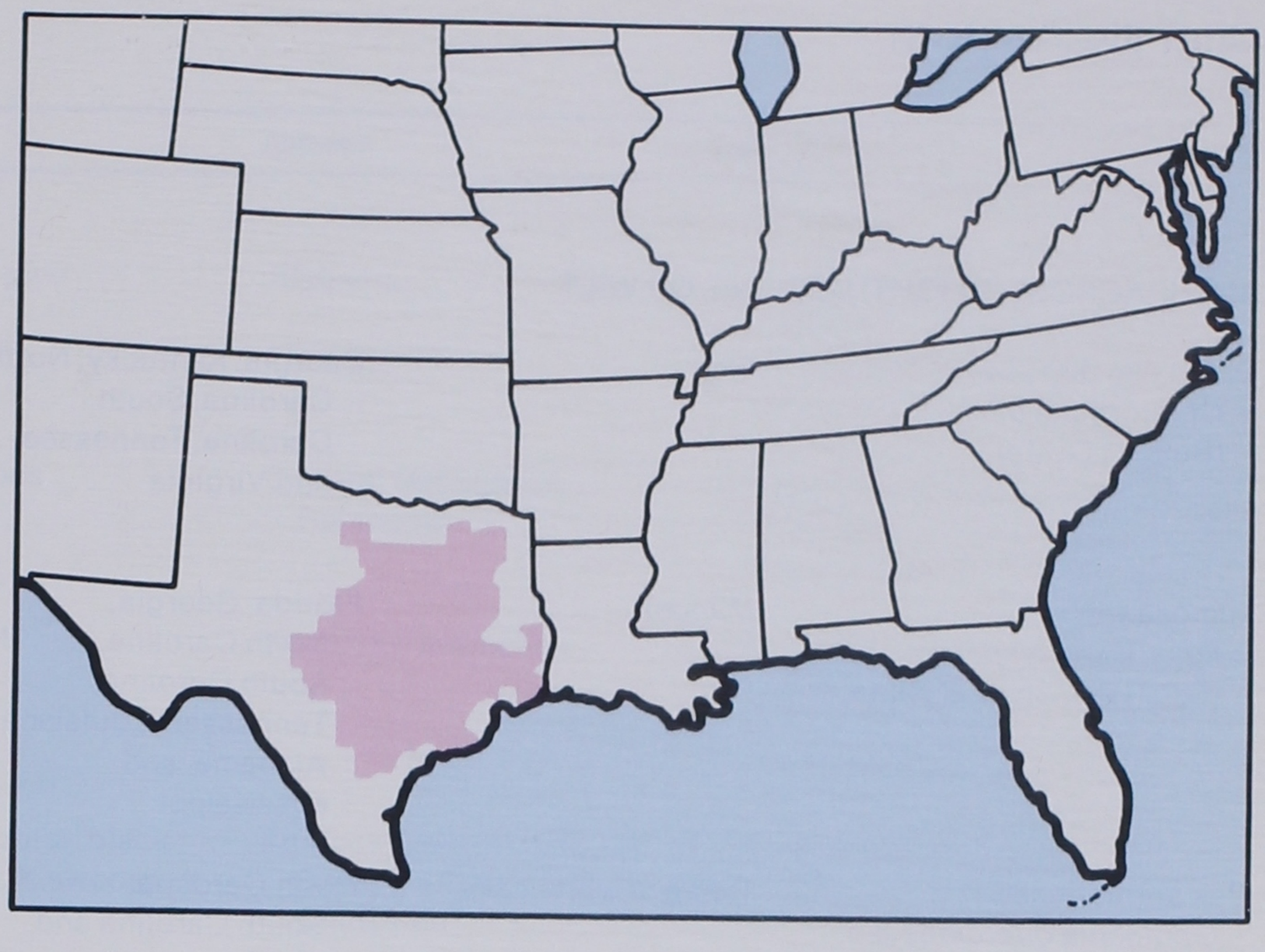
The oak wilt fungus was recently isolated from wilting live oaks in Bandera, Blanco, Gillespie, Kerr, McLennan, and Midland Counties in Texas. These trees were showing symptoms of a disease syndrome known as live oak decline. In addition to live oak, similar symptoms have been described on dying or declining post, water, southern red, and laurel oaks. Another fungus, *Cephalosporium diospryi* Crandall is still considered to be a major pathogen in the syndrome, and at least 10 other genera of fungi have been isolated from diseased roots. It is expected that this situation will have a negative effect on intra-national sales of oak nursery stock from Texas nurseries.



Distribution of loblolly pine plantations with 51 to 100 percent of the stems infected by C. quercuum *f. sp.* fusiforme.

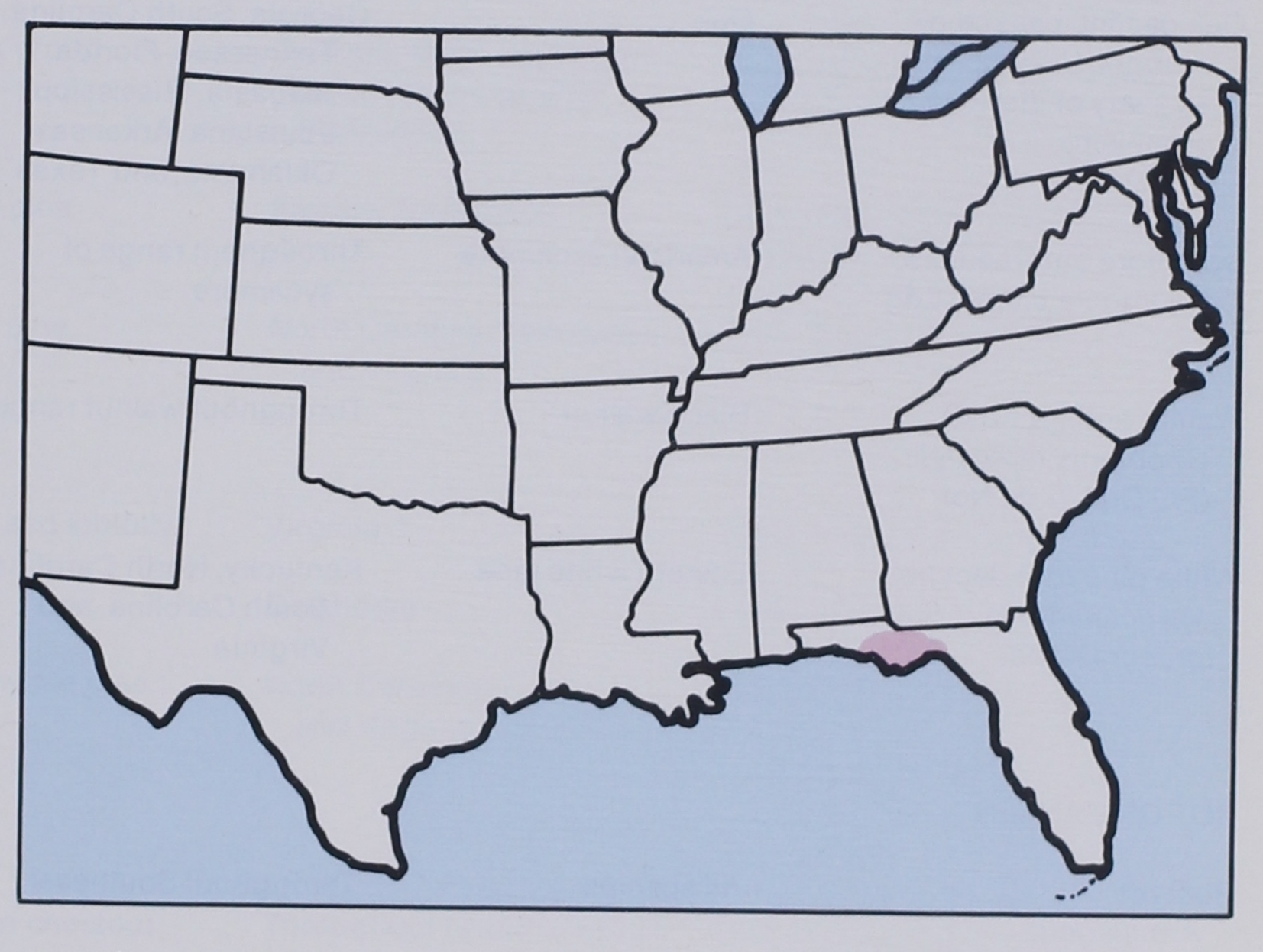
Table 14. — *State acreages of slash and loblolly pines with at least 10 percent of the trees having main stem or potential main stem fusiform infections*

State	Ownership			
	National Forest	Other Federal	State	Private
Alabama	61,900	20,100	20,100	1,938,900
Arkansas	6,500	1,200	850	50,400
Florida	47,000	28,400	22,500	1,020,200
Georgia	78,500	71,600	14,800	3,871,700
Louisiana	61,300	15,700	31,400	1,461,700
Mississippi	86,500	6,700	6,800	1,585,200
North Carolina	28,700	9,600	9,700	1,296,300
South Carolina	82,200	32,000	47,900	1,322,000
Texas	36,500	1,300	1,400	461,800
Virginia	—	—	—	6,016
Total	489,100	186,600	155,450	13,014,216



Texas counties with reported occurrence of live oak decline as of 1979.

Pitch canker, incited by *Fusarium moniliforme* var. *subglutinans* Wr. & Reink, continued to cause serious losses in southern pine management. The fungus induces canker formation on a wide variety of commercial pine hosts including slash, longleaf, shortleaf, loblolly, Virginia, eastern white, Scots, sand, tablemountain, pitch, and Monterey pines. During 1979, pitch canker activity was seen in Florida, Georgia, North Carolina, South Carolina, Tennessee, Virginia, Alabama, Mississippi, and Louisiana. Although disease-caused mortality decreased to moderate levels in plantation pines, observations in northern Florida seed orchards revealed severe damage to trees. Conditions still prevailed throughout the pine range that would permit further severe damage.



Area of increased pitch canker activity.

Other diseases (R-8)

Disease	Host	Location	Remarks
ANTHRACNOSE, BLIGHT, DECLINE, OR WILT			
Dutch elm disease *Ceratocystis ulmi* (Buism.) C. Mor.	Elm	Georgia, Kentucky, North Carolina, South Carolina, Tennessee, and Virginia	Mortality varies from 0 to 80 percent depending on the length of time since the first infection occurred in an area.
Mimosa wilt *Fusarium oxysporum* (Schl.) em. Snyd. & Hans.	Mimosa	Florida, Georgia, North Carolina, South Carolina, Tennessee, Louisiana, Alabama, and Mississippi	Has killed many trees. Resistant trees are taking the place of nonresistant trees through planting.
Oak anthracnose *Gnomonia quercina* Kleb.	Red and white oaks	North Carolina, South Carolina and Virginia	Defoliation was light to moderate.
Oak decline caused by drought, insects, and a variety of disease organisms.	Oak	Georgia, South Carolina, Tennessee, Florida, Alabama, Mississippi, Louisiana, Arkansas, Oklahoma, and Texas	Scattered throughout these States, especially severe in Appalachian Mountain area.
Sycamore anthracnose, *Gnomonia platani* Edg.	American sycamore	Throughout range of sycamore	Severe defoliation with branch dieback. Mortality occurred only in stressed trees.
Walnut anthracnose *Gnomonia leptostyla* (Fr.) Ces. & de Not.	Black walnut	Throughout walnut range	Moderate to complete defoliation. Seemed to be more severe on stress sites.
White pine root decline *Verticicladiella procera* Kend.	Eastern white pine	Kentucky, North Carolina, South Carolina, and Virginia	Scattered dying of white pine, primarily on wet sites. One 1/2-acre kill of 30-year-old white pine was reported in North Carolina.
ROT OR CANKER			
Root rot *Armillariella (Armillaria) mellea* (Fr.) Karst. *Armillariella (Clitocybe) tabescens* (Fr.) Singer *Phaeolus (Polyporus) schweinitzii* (Fr.) Pat. *Phytophthora* sp.	All species	Throughout Southeast	Annual losses are estimated at 1 to 2% with a range of 0 to 80% in individual stands.

Other diseases (R-8) continued

Disease	Host	Location	Remarks
Root rot *Ganoderma tsugae* Murr.	Loblolly pine	Alabama	Serious damage in a seed orchard.
	Oak	Florida	Associated with new housing disturbance.
Decay, primarily fungi in the Polyporaceae	Hardwoods	General throughout Southeast	Causing substantial losses. Especially severe where hardwoods have been burned.
Butternut canker *Sirococcus* sp.	Butternut	Kentucky to Virginia	Most of the sapling and larger trees are dead or infected. Nut production seems reduced on infected trees.
Fusarium canker *Fusarium solani* (Mart.) App. & Wr. em. Snyd. and Hans.	Yellow poplar, black walnut, & sweetgum	Kentucky, North Carolina, South Carolina, and Tennessee	Caused up to 90% losses in grafted seed orchards.
Hypoxylon canker *Hypoxylon atropunctatum* (Schw. ex Fr.) Cke.	Red oak group	Georgia, North Carolina, South Carolina, and Tennessee	Scattered mortality of weakened trees.
Comandra rust *Cronartium comandrae* Pk.	Loblolly pine	Eastern Tennessee	Found over a 10-county area — damage still light.
Eastern gall rust *Cronartium quercuum* (Berk.) Miy. ex. Shirai f. sp. *quercuum*	Virginia pine	North Carolina, Tennessee, and Virginia	Light damage.
Sweet fern blister rust *Cronartium comptoniae* Arth.	Virginia and loblolly pine	Virginia	Especially severe in droughty areas.
		Oklahoma	Urban problem.
White pine blister rust *Cronartium ribicola* Fisch.	Eastern white pine	North Carolina and Virginia	Low throughout known range. 1979 survey showed infection remains low in parts of Virginia even though ribes eradication had been stopped.
Chestnut blight *Endothia parasitica* (Murr.) P. J. and H. W. And.	American chestnut	Throughout chestnut range	Almost complete mortality of older trees. The hypovirulent strains give hope that the disease may be controlled.
Black knot *Dibotryon morbosum* (Schw.) Th. and Syd.	Black cherry	Georgia, Kentucky, North Carolina, South Carolina, and Tennessee	Light to severe losses reported. May limit species development in some locations.

Other diseases (R-8) continued

Disease	Host	Location	Remarks
LEAF OR NEEDLE DISEASES			
Actinopelte leaf spot *Actinopelte dryina* (Sacc.) Hoehn.	Red oaks	North Carolina, Tennessee, and Virginia	Especially severe on pin oaks.
Melampsora rust *Melampsora medusae* Thum.	Poplars	Throughout poplar range	Caused premature defoliation of the species.
Oak leaf blister *Taphrina caerulescens* (Mont. & Desm.) Tul.	Red oaks	Georgia, Kentucky, North Carolina, South Carolina, and Tennessee	Scattered throughout range, but not severe enough to cause defoliation.
Pine needle rust *Coleosporium* sp.	Hard pines	Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, and Tennessee	Little damage, but widespread.
Powdery mildew *Microsphaera alni* DC. ex Wint.	Oak, catalpa, and poplar	Florida, Georgia, and Tennessee	No damage.
Tar spot *Rhytisma acerinum* Pers. ex Fr.	Maple	Florida, Georgia, North Carolina, and South Carolina	No damage to host.
ABIOTIC			
Drought	Maple, oak, black gum, poplar, and American chestnut	Kentucky and Tennessee	Caused wilting and leaf fall and death of severely stressed trees.
Hurricane	All species	Alabama, Florida, Mississippi, and Louisiana	Forest timber damage estimate is $335 million in Alabama from Hurricane Frederic. Less severe damage in Florida (David), Mississippi (Frederic), and Louisiana (Bob).
Ice	Loblolly & hardwoods	Georgia; South Carolina; Tennessee; Zuitman County, Miss.; and North and Central Louisiana	Several thousand acres were damaged. In some cases the damage was severe enough to warrant salvage operations. Decay may follow in hardwoods. Moderate seed orchard damage.

Other diseases (R-8) continued

Disease	Host	Location	Remarks
Pollution			
Bromine	All species	Rockwood, Tenn.	Moderate to severe damage around bromine spill.
Ozone	Eastern white pine	North Carolina, South Carolina, and Virginia	Scattered browning of about 10% of trees.
Salt	Hardwoods	South Carolina and Tennessee	Foliage necrosis; roadside.
		Alabama	After Hurricane Frederic.
Snow	Maple, ash, locust, boxelder, hackberry, sycamore, and beech	Tennessee	Limb breakage.
Tornado	All species	Tennessee	Salvaged 1,423,000 board feet at the Chuck Swain State Forest and Wildlife Management Area.
Winter drying	Loblolly pine	Tennessee	Foliage necrosis with no mortality.
OTHER PROBLEMS			
Eucalyptus leaf and stem diseases *Gloeosporium* sp. *Cylindrocladium scoparium* Morg., *Alternaria* sp., *Pestalotia* sp., *Diaporthe* sp.	Eucalyptus	Southern Florida	Leaf damage under field conditions was very light. One 50-acre stand was heavily damaged by stem cankers. Cankers caused little damage elsewhere.
Nematode *Bursaphelenchus* sp.	Loblolly pine	Alabama	Unknown species reported associated with trees killed by southern pine beetle.
Slime flux *Erwinia nimipressuralis* Cart.	Oak	Northern Georgia, Kentucky, North Carolina, South Carolina, Tennessee, and Virginia	About 0.1 percent of the oaks seem to be affected; usually associated with decay or an injury.
NURSERY DISEASES			
Fusiform rust *Cronartium quercuum* (Berk.) Miy. ex Shirai f. sp. *fusiforme*	Slash pine	Florida	Single nursery with unusually high (25% +) infection.

Other diseases (R-8) continued

Disease	Host	Location	Remarks
Leaf rust *Melampsora* sp.	Cottonwood	Louisiana	Late season problem in one nursery; no real damage.
Root rot *Cylindroclandium floridanum* Sobers	White pine	North Carolina	Continued low-level loss.
Root rot *Cylindrocladium scoparium* Morgan	Eucalyptus	Florida	Loss of 200,000 seedlings. Second crop of 250,000 seedlings treated with fungicide successfully.
	Sweetgum	North Carolina	Very low level.
Root rot *Pythium* sp., *Fusarium* sp., *Rhizoctonia* sp.	Southern yellow pines	Arkansas, Louisiana, Alabama, and Mississippi	Present in several nurseries at low levels.
Root rot (Cause unknown)	Southern yellow pines	Alabama	Infection rate varies from 10 to 90%, depending on location within nursery, in each of two State nurseries.
Tip blight *Diplodia* sp. *Phomopsis* sp.	Loblolly and slash pines	Florida, Texas, Arkansas, and Mississippi	Caused widespread seedling dieback in several nurseries.

Eastern Region (R-9) and Northeastern Area[1]

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Conditions in Brief

Defoliation of spruce and fir by spruce budworm in New England and the Lake States totaled 6.6 million acres in 1979, with the vast majority occurring in Maine. Damage was heavier than in 1978 in all States but Maine, and populations are expected to remain high throughout the area in 1980.

Approximately 654,000 acres were defoliated in 1979 by the gypsy moth, which is considerably less than the 1,271,990 acres defoliated in 1978. Except for Vermont, defoliation was heavier in New England this year, but less in New York, New Jersey, and Pennsylvania.

Defoliation of various hardwoods by the forest tent caterpillar was generally light except in two large outbreaks— one in Maine (80,000 acres) and one in Minnesota (10,000 acres).

Many oaks throughout the Region were defoliated by numerous insects besides the gypsy moth and forest tent caterpillar, especially those insects in the leaf tier and roller complex.

The North American strain of Scleroderris canker continued to cause mortality in young pine plantations in the Lake States, New York, Vermont, and one plantation in Maine. The more damaging European strain was still confined to northern New York, Vermont, and one plantation in New Hampshire.

Well-managed control programs were generally helpful in reducing the rate of spread of Dutch elm disease in 1979, although some localities showed much greater mortality this year.

There was adequate rainfall during the year's growing season in most of the Region, but the effects of the 1976-77 drought were still seen. Related stress-induced dieback and mortality affected several hardwood species such as oak and maple.

Mortality in forest nurseries throughout the Region this year was attributed to a variety of causes including root rots, foliar diseases, nematodes, and cutworms.

A new cause of pine mortality, the pine wood nematode, was first found in this country in an Austrian pine in Missouri in February 1979. Most of the subsequent cases involved Scots pine. Whether the nematode will remain a pest of ornamentals, or become an epidemic problem in forest stands as it has in Japan, remains to be seen.

Status of Insects

Spruce budworm, *Choristoneura fumiferana* (Clemens), was the most damaging insect in the Region in 1979. Eighty-nine percent of the acreage defoliated was in Maine, the State with the only spray project (table 15). Approximately 2.7 million acres were treated with carbaryl, acephate, trichlorfon and Bacillus thuringiensis. Acceptable foliage protection was obtained with all the materials. The other States confined their control programs to salvage and presalvage of declining stands. Defoliation in New Hampshire was greater than last year and shifted southward and eastward. Populations intensified in New Hampshire and Vermont over the past few years and are predicted to remain high in both States in 1980.

There were two separate infestations in Wisconsin. In the northeastern part of the State, 140,000 acres were defoliated in 1979. Heavy balsam mortality has occurred on 10,000 acres since 1974. Only 1,300 acres were defoliated in the Upper Peninsula of Michigan while a small infestation (160 acres) was also found in the Lower Peninsula. In Minnesota, spruce budworm populations increased somewhat in 1979.

F-702379

Balsam fir defoliated by the spruce budworm near Shoepack Lake, Mich.

[1] Includes forests in Connecticut, Illinois, Indiana, Iowa, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, Maine, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin.

Gypsy moth, *Lymantria dispar* (L.), continued to spread and cause extensive dofoliation. Although considerably more acres were defoliated in most of the New England States this year, the areawide total was only about half of last year's, mainly because of the marked decrease in Pennsylvania (table 16).

Over 100,000 acres were treated with a variety of chemicals including carbaryl, diflubenzuron, and trichlorfon and biological control agents (insect parasites and *Bacillus thuringiensis*, the gypsy moth virus, and the pheromone disparlure). Some of these treatments successfully reduced populations, but the effects of others were inconclusive because of natural population collapses. Male moths were trapped in Maryland, Minnesota, Ohio, West Virginia, and Wisconsin; however, no defoliation was observed in these areas.

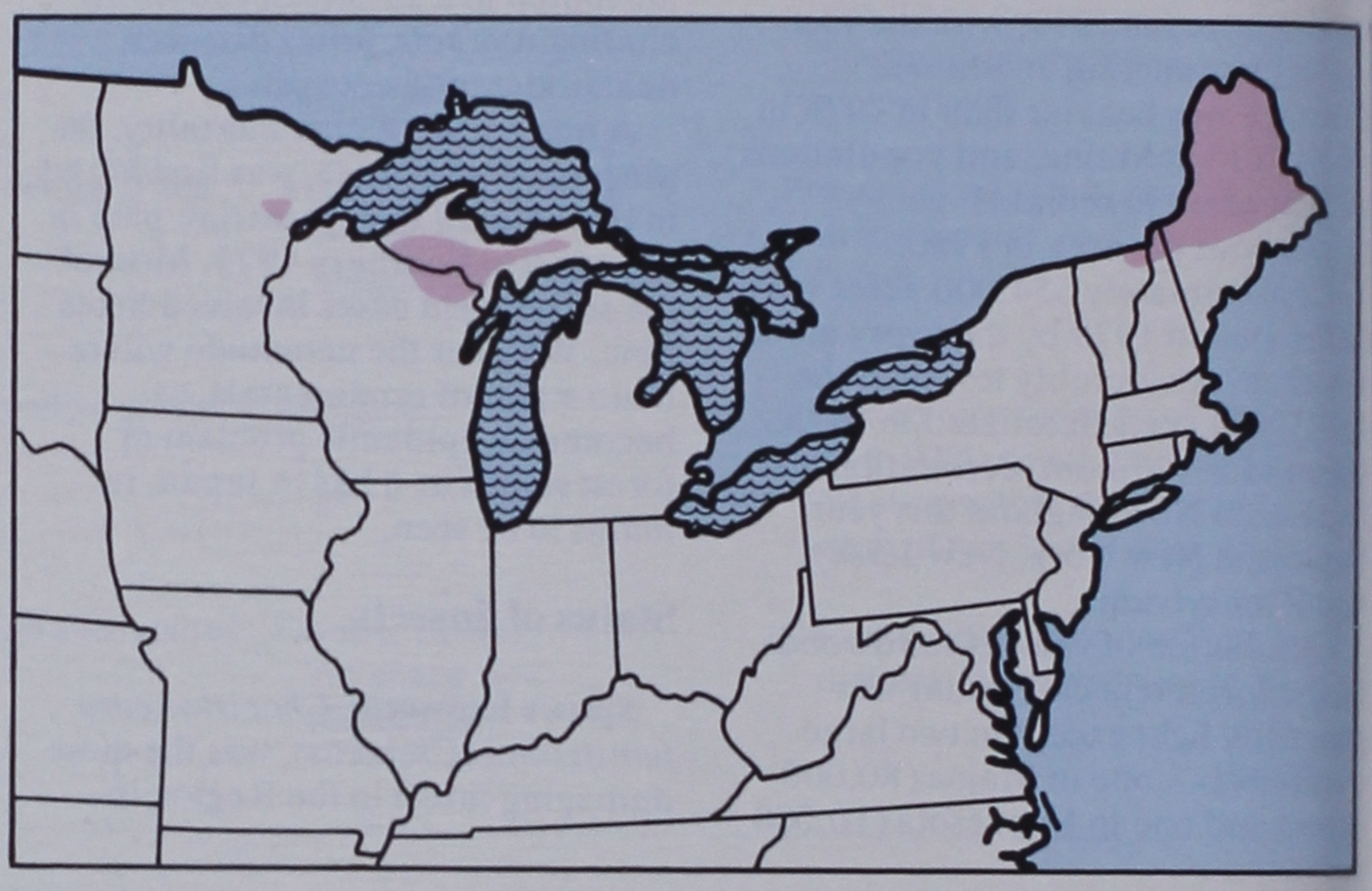
Forest tent caterpillar, *Malacosoma disstria* Hbn., is endemic throughout the Northeast and generally caused little defoliation except in three States. An unexpected outbreak in Maine resulted in medium to heavy defoliation on 50,000 to 80,000 acres. For the third year, the forest tent caterpillar caused heavy defoliation in northern Minnesota, but refoliation followed with little noticeable damage to the trees. In northwestern Wisconsin, there was scattered light to heavy defoliation of aspen on 80,500 acres.

Oak defoliators along with the gypsy moth and forest tent caterpillar, caused widespread defoliation of oaks throughout the Northeastern Region. The major insects involved were *Croesia semipurpurana* (Kft.), *Archips* spp., *Pseudexentera* sp., and *Phigalea titea* (Cram.). The States that reported the most damage were Pennsylvania, Maine, Massachusetts, and West Virginia.

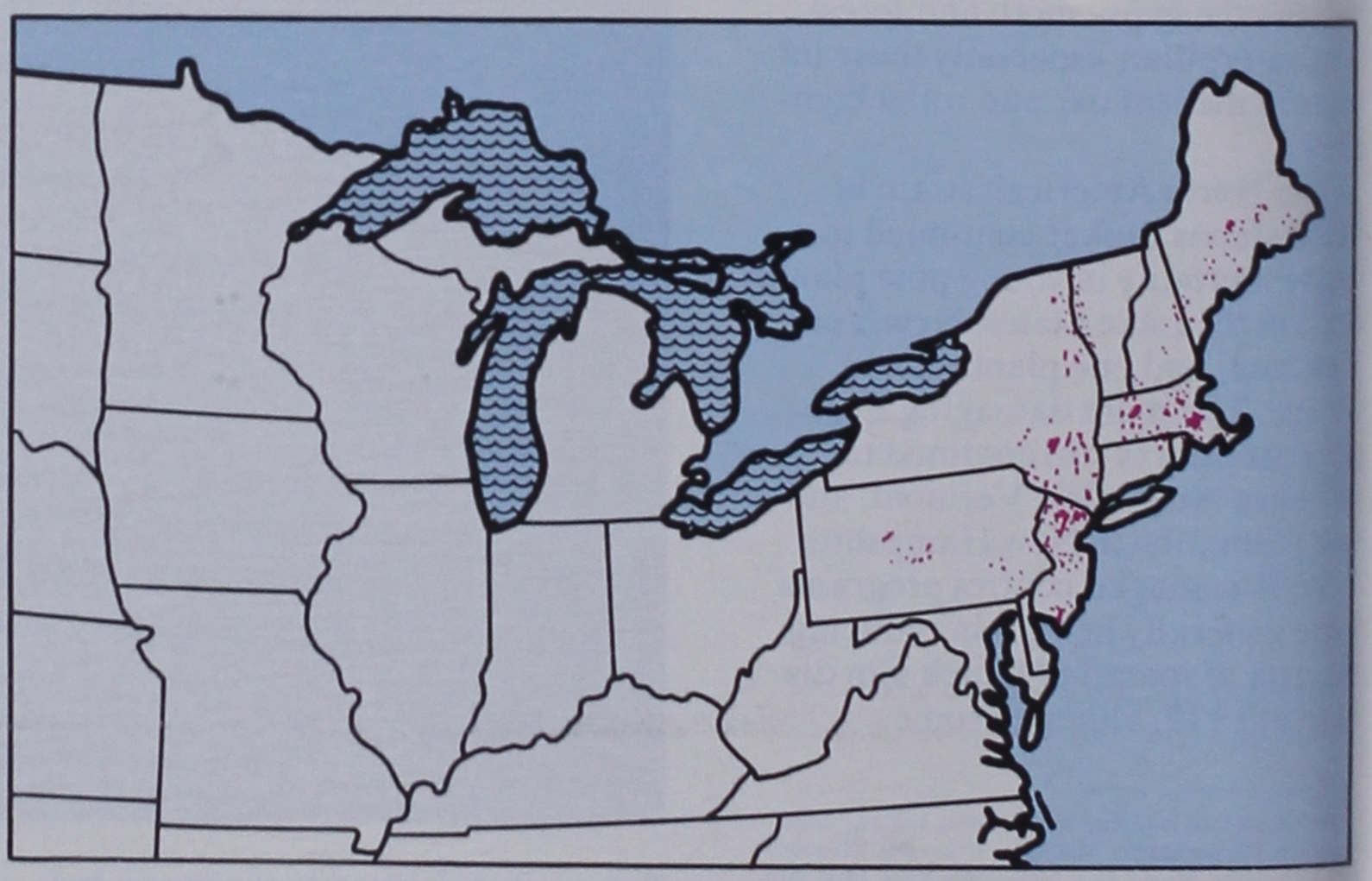
Jack pine budworm, *Choristoneura pinus* Freeman, is a major defoliator of jack pine and was active this year in the Lake States. A building population was detected in both the Upper Peninsula and Lower Peninsula of Michigan. Approximately 12,000 acres of light to moderate defoliation occurred in the Lower

Table 15. — *Northeastern Area spruce budworm defoliation — 1979*

State	Light	Medium	Heavy	Total
		Acres		
Maine	—	—	—	5,900,000
Michigan	73,590	147,632	37,600	258,822
Minnesota	—	—	—	150,000
New Hampshire	—	—	—	70,000
Vermont	—	90,923	11,000	101,923
Wisconsin	—	—	—	141,300
Total	73,590	238,555	48,600	6,622,045



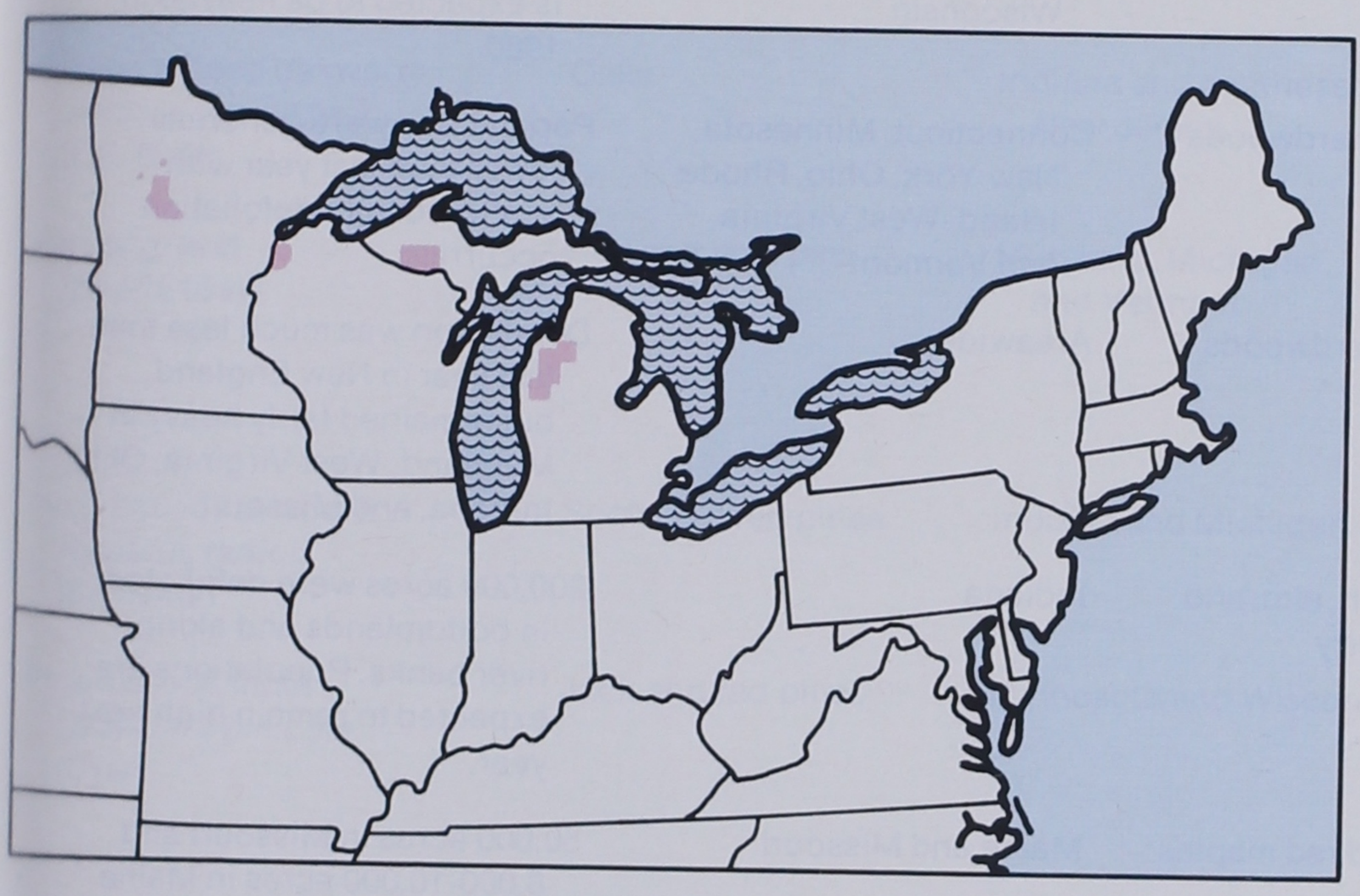
Areas of eastern spruce budworm infestations.



Gypsy moth defoliated areas.

Table 16. — *Northeastern Area gypsy moth defoliation — 1979*

State	0-30%	31-60%	61-100%	Total	1978 Total
	----------	----------	Acres	----------	----------
Connecticut	6,784	234	468	7,486	3,835
Delaware	10	—	—	10	—
Maine	4,290	16,760	2,130	23,180	4,120
Massachusetts	125,805	74,145	26,310	226,260	63,042
Michigan	—	—	100	100	—
New Hampshire	2,960	1,900	1,120	5,980	725
New Jersey	56,035	74,910	62,755	193,700	204,330
New York	76,450	30,450	55,375	162,275	500,046
Pennsylvania	—	6,840	1,712	8,552	452,892
Rhode Island	105	—	550	655	—
Vermont	10,117	7,625	10,925	28,667	43,000
Total	282,556	212,864	161,445	656,865	1,271,990



Jack pine budworm infestations.

Peninsula. In northwestern Wisconsin, heavy to severe defoliation occurred on 15,000 acres with light to moderate defoliation on another 15,000 acres. This outbreak is expected to increase and spread eastward next year. Populations declined this year in Minnesota and are expected to do so again in 1980. Moderate to heavy damage occurred on 15,500 acres this year.

Status of Diseases

White pine blister rust, caused by the fungus *Cronartium ribicola* Fischer, was the most damaging disease of white pine in the Northeastern Region. However, with proper site selection and the use of rust resistant planting stock, white pine can be grown successfully. In 1979, 12,000 rust resistant seedlings were planted on two National Forests in the Lake States and at least twice that number are scheduled to be planted in 1980.

Vascular wilts. Dutch elm disease, caused by *Ceratocystis ulmi* (Buism.) C. Mor., is present throughout most of the Northeastern Region and, in 1979, continued to kill elms where they still existed. Integrated control programs, which may include surveys, sanitation, root graft control, chemical injection, and pruning of affected limbs, enabled communities to reduce their annual elm mortality. In communities without such programs and in the forest where

Other insects (R-9)

Insect	Host	Location	Remarks
Birch leaf miner *Fenusa pusilla* (Lepeletier)	Birches	Michigan, Rhode Island, northern Wisconsin, and Vermont	Moderate to heavy defoliation in the Lake States and Rhode Island, but light in Vermont.
Bronze birch borer *Agrilus anxius* Gory	Birches	Areawide	Damage especially heavy in northwestern Wisconsin and southern Indiana.

Other insects (R-9) continued

Insect	Host	Location	Remarks
Cherry scallop shell moth *Hydria prunivorata*	Black and choke cherries	New York and Pennsylvania	Defoliated 25,000 acres in New York and 2,000 acres in Pennsylvania.
Eastern tent caterpillar *Malacosoma americana* (F.)	Cherries	Areawide	Populations were very high in several States (Connecticut, Indiana, Missouri, New Jersey, and West Virginia) and may continue to be high in 1980 before reaching the decline phase of its 8-12 year cycle.
European pine sawfly *Neodiprion sertifer* (Geoffroy)	Austrian, red, and Scots pines	Indiana, Michigan, New Jersey, and Wisconsin	Defoliation was heavy in local areas in several States and is expected to be heavier in 1980.
Fall cankerworm *Alsophila pometaria* (Harris)	Northern hardwoods	Connecticut, Minnesota, New York, Ohio, Rhode Island, West Virginia, and Vermont	Populations were generally lower than last year with scattered light defoliation occurring.
Fall webworm *Hyphantria cunea* (Drury)	Various hardwoods	Areawide	Defoliation was much less than last year in New England, but remained fairly heavy in Maryland, West Virginia, Ohio, Indiana, and Missouri.
Green fruitworm *Lithoplane antennata* (Walker)	Maple, ash, elm, and hackberry	Indiana	200,000 acres were defoliated in bottomlands and along river banks. Populations are expected to remain high next year.
Greenstriped mapleworm *Anisota rubicunda* (F.)	Silver and red maples	Maine and Missouri	50,000 acres in Missouri and 8,000-10,000 acres in Maine were defoliated.
Horned oak gall *Callirhytis cornigera*	Pin oak	Illinois and West Virginia	Usually a problem of ornamentals, this pest was causing twig death and tree mortality in forest stands in three different areas.
Introduced pine sawfly *Diprion similis* (Hartig)	White and Scots pine	Michigan, Wisconsin, and Vermont	Scattered light defoliation; mainly on ornamentals.
Larch casebearer *Coleophora laricella* (Hubner)	Larch	New York and Vermont	Light to moderate defoliation in northwest New York and light defoliation in Vermont.

Other insects (R-9) continued

Insect	Host	Location	Remarks
Larch sawfly *Pristiphora erichsonii* (Hartig)	Larch	Wisconsin	Populations and acres defoliated decreased. Only scattered stands were affected.
Linden looper *Erannis tiliaria* (Harris)	Various hardwoods, esp. oaks	Indiana, Missouri, and Ohio	Heavy defoliation occurred over wide areas. Reduced populations are expected in Missouri next year.
Locust leaf miner *Odontata (Xenochalepus) dorsalis* (Thunberg)	Black locust	Southern Indiana, eastern Iowa, Maryland, Ohio, southern Pennsylvania, and West Virginia	Moderate to heavy defoliation, with some tree mortality occurring in Maryland; populations were generally heavier than last year.
Orange striped oakworm *Anisota senatoria* J. E. Smith	Oaks	Indiana and southeastern New Jersey	Heavy defoliation in a few isolated areas.
Pine engraver *Ips pini* (Say)	Red and jack pine	Maryland, Michigan, and Vermont	Continues to cause damage, especially in drought-stressed trees and where suitable slash permits population buildups.
Pine root collar weevil *Hylobius radicis* Buchanan	Scots and red pines	Indiana and Michigan	Damage heavy in some young Scots pine plantations.
Pine tussock moth *Dasychira pinicola* (Dyar)	Jack and red pines	Minnesota and Wisconsin	Defoliation of 400 acres in Minnesota and 600 acres in Wisconsin, but expected to increase in 1980; Minnesota will spray for control.
Red pine scale *Matsucoccus resinosae* Bean & Godwin	Red pine	Connecticut, northern New Jersey, and southeastern New York	Continues to cause mortality and to spread at about 3 miles per year.
Saddled prominent *Heterocampa guttivitta* (Walker)	Northern hardwoods	Maine, northeastern New York, and Vermont.	39,340 acres defoliated in Vermont; moderate defoliation in northeastern New York; little defoliation in Maine. Increased populations expected next year in all three States.
Spittlebugs *Aphrophora* spp.	Red, Scots, and white pines	Michigan, Minnesota, Pennsylvania, and Wisconsin	Local problems in some plantations.

Other insects (R-9) continued

Insect	Host	Location	Remarks
Spring cankerworm *Paleacrita vernata* (Peck)	Various hardwoods	Missouri, Ohio, and Vermont	Heavy defoliation of oaks in east-central Missouri and Ohio; very light defoliation in Vermont.
Post-oak locust *Dendrotettix quercus* Packard	Oaks, dogwood, and red maple	Missouri and Wisconsin	Heavier and more widespread defoliation than last year.
White pine weevil *Pissodes strobi* (Peck)	White pine	Areawide.	Continues to be a problem on white pine throughout the area.
Yellow-headed spruce sawfly *Pikonema alaskensis* (Rohwer)	White spruce	Minnesota	Populations decreased, but are present in 88% of plantations; tree mortality is about 4%.
Zimmerman pine moth *Dioryctria zimmermani* (Grote)	Red pine	Michigan and Wisconsin	In Wisconsin, heavy damage to terminal shoots for past several years has caused stagnation of height growth.

controls were not practical, damage remained heavy in 1979, especially in West Virginia and Pennsylvania.

Six Minnesota cities that participated in a Federal Dutch elm disease demonstration control program successfully reduced the incidence of disease in 1979 below the 1978 level. Disease in 1979 averaged 21 percent less than that in 1978. Wisconsin's 18 cities in the program were not as successful. Only eight of the cities reduced the level of disease incidence. In these cities the average incidence was reduced from 9 percent in 1978 to 6.5 percent in 1979. In the other 10 cities the average rate of infection rose from 10 percent to 15.6 percent. Some wood utilization programs took place in Wisconsin and Minnesota during 1979, and there will be a major utilization thrust in 1980 involving all participating communities from both States.

Oak wilt, caused by the fungus *Ceratocystis fagacearum* (Bretz) Hunt is present throughout the Midwest from Pennsylvania to Iowa and from central Wisconsin to Tennessee. In 1979, it continued to spread into previously uninfected areas. Regulations restricting the movement of oak wilt-infected logs from the United States to Europe are being developed by the USDA Animal and Plant Health Inspection Service (APHIS) and the European Common Market. These regulations could have a serious impact on the export of oak.

Scleroderris canker is caused by two strains of the fungus *Gremmeniella abietina* (Lagerberg) Morelet. One strain, called the North American strain, primarily causes mortality of trees less than 5 feet tall and is most significant in reforestation plantations and nurseries. A second strain, called the European strain, can kill trees of any age. In 1979 the disease continued to cause damage to red, jack, and Scots pines. New infection centers of both strains were found this year but all were located in counties where scleroderris had been previously reported, except for Carlton County, Minn. In June 1979, six pine species in an experi-

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Gremmeniella (scleroderris) canker on red pine.

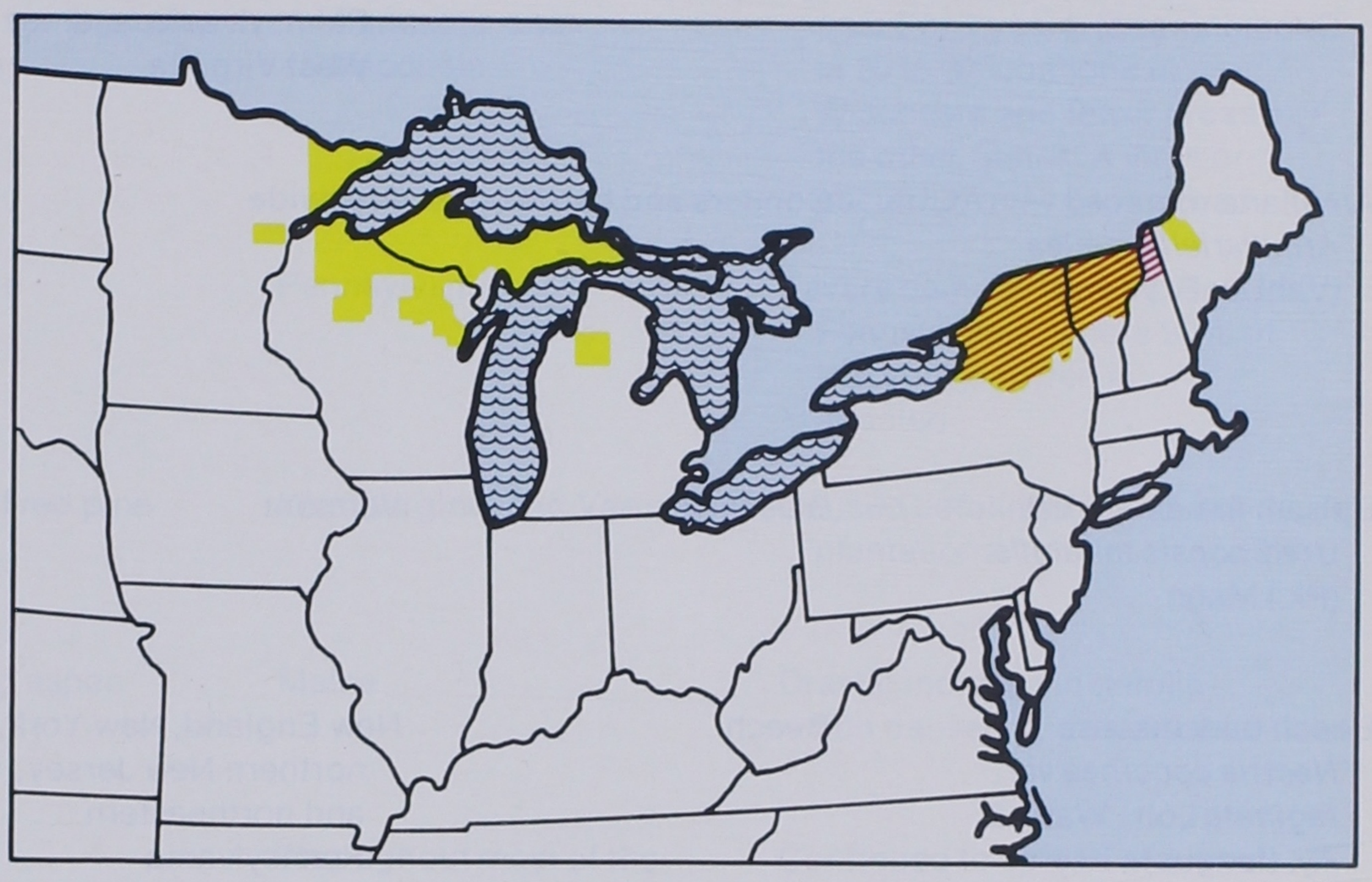
mental planting near Cloquet, Minn., were found to be heavily infected with scleroderris cankers. The source of inoculum for these infections by the North American strain of the fungus is not known. In Vermont, 70 plantations (600 acres) were infected by the European strain, while in New York the fungus was found on about 50,000 acres. Quarantines of affected counties in these two States remained in effect. Only one plantation in New Hampshire (European strain) and one in Maine (North American strain) were infected. However, there are several plantations in Quebec, Canada, just north of the Maine, New Hampshire, and Vermont borders that were infected with the European strain.

Beech bark disease results from the combined effects of a scale insect, *Cryptococcus fagisuga* Lind., and a fungus, *Nectria coccinea* Var. *Faginata* Loh., Wats. & Ay. The disease is present throughout New England and New York, and in 1979 it was spreading west and south into Pennsylvania and New Jersey. A second wave of the disease is killing beech regeneration in areas previously infected.

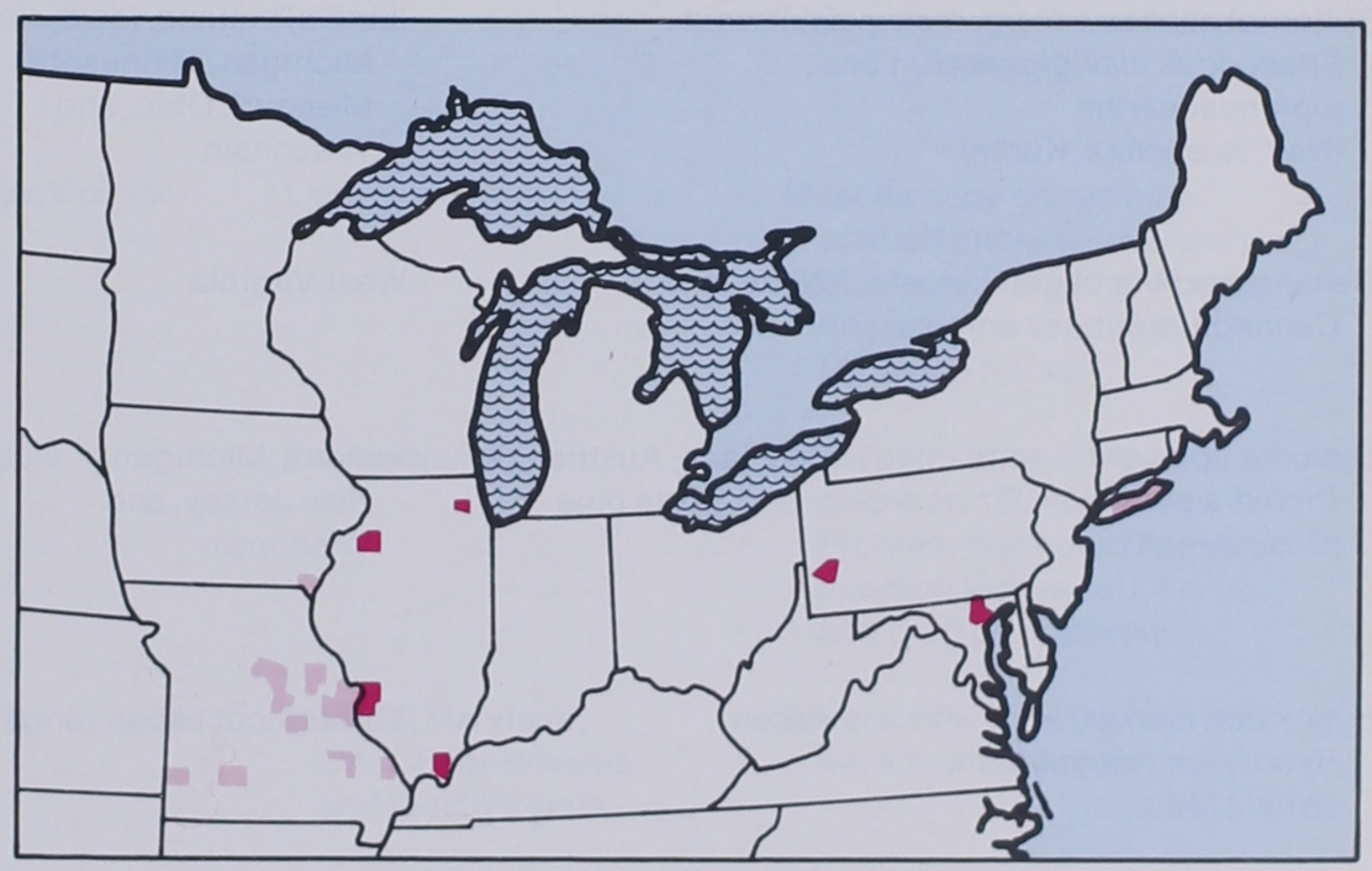
Diebacks and declines were observed this year in many States on several species of hardwoods. Ash dieback was reported in Indiana, Ohio, New York, and Vermont, while in southern Wisconsin many ashes experienced unexplained premature leaf fall. Stress-induced dieback and mortality of oaks in Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, and Wisconsin often were associated with drought, Armillaria root rot, and two-lined chestnut borers. In Indiana alone, an estimated 321,778 board feet of affected oaks were lost. Maple decline occurred in the western Upper Peninsula of Michigan, northern Wisconsin, southern Minnesota, and the sugar bushes of Vermont. Dieback of paper birch in Minnesota and yellow birch in Vermont and the western Upper Peninsula of Michigan was prevalent this year. Damage to walnut was associated with winter injury in Wisconsin and cankers of unknown cause in Iowa.

Decline of dogwoods, characterized by sparse foliage, wilted and stunted leaves, and dead branches, occurred over extensive areas in northern New Jersey and eastern Pennsylvania.

Pine wood nematode, *Bursaphelenchus lignicolus* Mamiya & Kiyohara, causes a wilting disease of pines and was found for the first time in the United States (Missouri) in February 1979 in a recently killed Austrian pine. Since then, killing of Scots, mugho, loblolly, shortleaf, and Swiss stone pines by this nematode has been confirmed. Thus far most reported cases of the nematode involved ornamentals, especially Scots pine. The pine wood nematode is believed to be native to the United States and not introduced from Japan where it causes extensive mortality. Past pine mortality caused by this pest in the United States may have been incorrectly attributed to stress, bark beetle attack, and blue stain fungi.



Scleroderris canker distribution by counties.



Pine wood nematode distribution.

Other diseases (R-9)

Disease	Host	Location	Remarks
Air pollution	White pine	Minnesota, Missouri, and West Virginia	Other species also damaged, but white pine is generally the most sensitive.
Annosus root rot *Heterobasidion annosum* (Fr.) Bref.	Conifers	Areawide	Damage is light except in a few plantations.
Anthracnose *Gnomonia* spp.	Sycamore, ash, and oak	Indiana, Maryland, Pennsylvania, and West Virginia	Spring weather conducive to infection led to heavy defoliation this year in many areas.
Armillaria root rot *Armillariella mellea* (Vahl ex Fr.) Karst	Conifers and hardwoods	Areawide	Continued to be a widespread problem, particularly on stressed trees. In Vermont, it was prevalent on declining sugar maples and red spruce.
Balsam fir needle rust *Uredinopsis mirabilis* (Pk.) Magn.	Balsam fir	Vermont	Infection sufficiently heavy to make many trees unmerchantable as Christmas trees.
Beech bark disease *Nectria coccinea* var. *faginata* Loh., Wats. & Ay. (fungus) *Cryptococcus fagisuga* Lind. (vector)	Beech	New England, New York, northern New Jersey, and northeastern Pennsylvania	Continued to spread west and south. A second wave of the disease was spreading through New York and killing beech regenerated following the first wave.
Butternut canker *Sirococcus clavigignenti-juglandacearum* (Nair, Kostichka, Kuntz)	Butternut	Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin	Found in areas throughout the host range. In southwestern Wisconsin, 80% of the butternuts were cankered and 32% were dead.
Cenangium twig blight *Cenangium* sp.	White pine	West Virginia	Several thousand acres of white pine regeneration damage.
Diplodia tip blight *Diplodia pinea* (Desm.) Kickx.	Red, jack, Austrian, and Scots pine	Indiana, Michigan, New Jersey, and Wisconsin	Found killing current year's growth and occasionally entire branches, in forest stands, ornamentals, and nurseries.
Hypoxylon canker *Hypoxylon mammatum* (Whal.) Mill.	Aspen	Throughout aspen range	Continues to cause mortality, especially damaging in young aspen stands.

Other diseases (R-9) continued

Disease	Host	Location	Remarks
Larch decline (Unknown cause)	Larch	Vermont	Mortality first noticed 10 years ago in small scattered centers and incidence has increased over the years. Populations of eastern larch beetle are now heavy in decline areas.
Leaf bronzing of aspen (Unknown cause)	Trembling and Bigtooth aspen; some poplar hybrids	Iowa, Michigan, Minnesota, and Wisconsin	Symptoms observed for only the past 6 or 7 years. Present in 20 to 30 locations in Wisconsin and fewer areas in the other States. A virus or bacterium may be involved.
Leaf spot *Phyllosticta minima* (B. & C.) E. & E.	Red maple	Pennsylvania	Severe damage in south central Pennsylvania, where 90% of leaf surface often is affected.
Lophodermium needlecast *Lophodermium pinastri* (Schrad. ex Hook) Chev.	Scots and red pine	West Virginia and Vermont	Caused defoliation in several plantations.
Marssonina leaf spot *Marssonina populi* (Lib.) Magn.	Trembling aspen	Maine	Drastic increase in defoliation caused by this disease.
Oak wilt *Ceratocystis fagacearum* (Bretz) Hunt	Oak	Throughout most of the oak range in Area	Continued to spread at a rate similar to previous years.
Russian olive dieback *Botryodiplodia theobramae* (B. & C.) Cke.	Russian olive	Indiana	Heavy damage to a windbreak and nursery.
Sirococcus shoot blight *Sirococcus strobilinus* Preuss.	Red and jack pines	Lake States	Most damage on red pine planted under an overstory of infected red pine. Found on jack pine seedlings in a Michigan nursery.
Sugar maple defoliation (Unknown cause)	Sugar maple	Pennsylvania	Total defoliation of sugar maple on 155,400 acres. Problem first noted this year in which leaves curl, dry up, and drop prematurely.
White pine root decline *Verticicladiella procera* (Kend.)	White pine	Indiana, Maryland, Ohio, Pennsylvania, and West Virginia	Several new infection centers were found this year.

Alaska Region (R-10)[1]

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Conditions in Brief

Bark beetle activity continued to cause the most insect damage to forested areas in Alaska during 1979. Infestations covered 370,650 acres of white spruce, an increase of 247,100 acres over the area infested in 1978. White spruce mortality occurred on 31,115 acres of the Chugach National Forest; a 50-percent increase over 1978 infested areas. Approximately 8,710 acres of white spruce were infested by *Ips* in interior Alaska. Eastern larch beetle infestations decreased for the third consecutive year. Only 16,000 acres of scattered larch mortality were detected in 1979.

For the second year, large aspen tortrix populations remained high in south-central Alaska. In 1979 near Willow, Alaska, 26,771 acres of defoliated aspen were observed. The spruce budmoth (*Zeiraphera* sp.) defoliated 2,805 acres of white spruce northwest of Dillingham. Spruce budworm (*Choristoneura* sp.) was again collected in large numbers in localized areas around Anchorage.

In southeast Alaska, populations of the hemlock sawfly and western black-headed budworm remained at endemic levels during 1979. A third defoliator of western hemlock, the saddleback looper, continued to increase in numbers, particularly south of Frederick Sound. Cedar mortality was observed in small patches throughout the Stikine (Petersburg) Area, the northern part of the Ketchikan Area, and Peril Strait on Chicagof Island.

Hemlock dwarf mistletoe, *Sirococcus* shoot blight and needle rust of white spruce continued to be the most damaging tree diseases in Alaska.

Table 17 summarizes the major forest insect and disease infestations in Alaska by ownership and pest.

Status of Insects

Spruce beetle, *Dendroctonus rufipennis* (Kby). Alaska spruce beetle populations dramatically increased in 1979. Infestations covered approximately 370,650 acres, an increase of 247,100 acres over the area infested in 1978. White spruce mortality occurred on 31,115 acres of the Chugach National Forest; an increase of 15,792 acres (50 percent) over the area infested in 1978. The Summit Lake infestation has increased from 800 acres in 1978 to 6,437 acres in 1979. Likewise, the Resurrection Creek infestation on the Kenai Peninsula (a high-value

Table 17. — *Forest insect and disease infestations in Alaska by ownership and pest — 1979*

Pest	National Forest	Other Federal	Native	State and private
	Acres			
Spruce beetle *Dendroctonus rufipennis*	31,115	26,321	60,000	270,388
Eastern larch beetle *D. simplex*	—	15,992	—	—
Engravers *Ips* spp.	—	3,595	5,115	—
Cottonwood leaf beetle *Chrysomela scripta*	—	—	—	100
Willow leaf miner *Rhynchaenus rufipes*	—	2,338	1,558	—
Large aspen tortrix *Choristoneura conflictana*	—	5,357	—	21,417
Spruce budworm *Choristoneura* spp.	—	—	—	100

[1] Includes forests in Alaska.

recreation area) has increased to 15,384 acres; an increase of 2,883 acres over 1978 levels.

Elsewhere on the Kenai Peninsula, spruce beetle activity is increasing. A total of 30,000 acres of white spruce is infested throughout the Kenai National Moose Range. The Barabara Lake infestation has increased by 3,195 acres over 1978 area (7,413 acres). Three new infestations totaling more than 2,807 acres were detected near Homer at the southern end of the Kenai Peninsula.

In 1978, approximately 64,246 acres of white spruce mortality occurred on the west side of Cook Inlet. In 1979, infestations covered 318,064 acres throughout this area of which 28,574 acres were moderate to heavily infested; the remainder being very light (1.2 infested trees per acre). The areas of heaviest infestation occurred north of Tuxedni Bay and lower Beluga Lake. This increased spruce beetle activity is probably a result of expanding pockets and emigrating beetles from the Tyonek outbreak of the late 1960's and early 1970's. Salvage operations are continued on these affected State lands. As of October 1979, a total of 63.4 million board feet of white spruce was harvested on the Westside Salvage Timber Sale. Approximately 80 percent of this volume was beetle-killed timber.

Throughout interior Alaska, spruce beetle activity was detected on 3,850 acres. The largest infestation (778 acres) was located approximately 10 miles northeast of Little Russian Mission along the Kuskokwim River. The 2,325-acre infestation aerially detected in 1978, 18 miles south of Devil's Elbow on the Kuskokwim River declined. No visible beetle activity was observed in 1979.

Spruce beetle infestations in 1979, by ownership, are as follows: National Forest land - 31,115 acres; State, private, and Cook Inlet Region, Inc. holdings or selections - 330,388 acres; and other Federal lands (e.g., Kenai National Moose Range and National Monuments) - 26,321 acres.

Eastern larch beetle, *Dendroctonus simplex* (LeC.). Eastern larch beetle infestations have decreased in the interior from 35,590 acres in 1978 to 15,992 acres in 1979. The largest concentrations of larch beetle activity (10,680 acres) occurred southeast of Fairbanks along the Tanana and Teklanika Rivers. Approximately 3,583 acres of infested larch occurred near Anvik along the Yukon River; the same area infested in 1978. Along the McKinley River, just outside the Mount McKinley National Park boundary, 1,500 acres of new larch beetle infestations were aerially detected. It appears that most of the susceptible tamarack was infested in the last 4 years and larch beetle activity has essentially run its course.

Engravers, *Ips pertubatus* (Eichh.). For the third consecutive year, engraver infestations increased in interior Alaska. Approximately 8,710 acres of white spruce were infested in 1979; an incease of 6,733 acres (77 percent) over the area infested in 1978. The largest infestation, approximately 5,115 acres, was located along the Chandalar River southwest of Venetie. This outbreak undoubtedly originated from the large quantity of white spruce slash left after road construction. Approximately

Table 17 **continued.**

Pest	National Forest	Other Federal	Native	State and private
	----------	Acres	----------	
Spruce budmoth *Zeiraphera* sp.	—	—	—	2,805
Western blackheaded budworm *Acleris gloverana*	—	—	—	247
Hardwood defoliation (causes unknown)	—	27,606	—	11,831
Spruce needle rust *Chrysomyxa ledicola*	—	13,343	13,343	40,030
Hemlock dwarf mistletoe *Arceuthobium tsugae*	30,958	—	—	—
Total insect	31,115	81,209	66,673	306,888
Total disease	30,958	13,343	13,343	40,030
State total - insect and disease - 582,559				

741 acres of scattered *Ips* kill were also aerially detected 10 miles northwest of Kiana along the Kobuk River.

Cottonwood leaf beetle, *Chrysomela scripta* F. Leaf beetle populations were low in southeast Alaska. No visible defoliation was detected from the air; however, several homeowners in the Mendenhall Valley north of Juneau reported moderate defoliation of ornamental cottonwoods.

Cedar mortality. Small patches of dying Alaska yellow cedar and western red cedar were readily observed throughout the central third of southeast Alaska. While growing site, root disease, and possiby *Phloeosinus* bark beetles are suspected as interacting causes of cedar mortality, the problem will be evaluated in greater depth during 1980. Currently, the most severely affected areas are the Stikine Area, the northern part of the Ketchikan Area, and Peril Strait in the Chatham Area.

Willow leaf miner, *Rhynchaenus rufipes* (LeC.). In 1979, aerial surveys detected 3,894 acres of defoliated willow along the Innoko River, due east of Anvik. Ground inspection of the affected area showed that a small weevil was responsible for the defoliation. The weevil was identified as *R. rufipes,* a new State record for Alaska. This species occurs from Newfoundland to Aklavid, Northwest Territory (now to northern Alaska). Larvae mine leaves of willow, elm, alder, apple, cherry, and birch.

Spruce budmoth, *Zeiraphera* sp. In 1979, aerial surveys detected 2,805 acres of heavy white spruce defoliation approximately 81 miles northwest of Dillingham between Lake Kulik and Grant Lake. A ground check of the affected area revealed an undetermined species of *Zeiraphera.* All the white spruce new growth and portions of the old growth were defoliated in all age classes.

Spruce budworm, *Choristoneura* sp. Similar to last year, ground surveys detected visible budworm damage to white spruce in many residential and park areas of Anchorage. The results of pheromone trapping indicated spruce budworm distribution as far north as Fairbanks. However, no visible signs of defoliation were observed outside of Anchorage.

Spruce budworm life history studies were undertaken throughout the 1979 field season. Preliminary results indicated a species complex; 5 percent of the population being *C. biennis* Free. and the remainder possibly being *C. fumiferana* Free. Efforts will be continued to delineate the budworm species and the impact of this defoliator complex.

Large aspen tortrix, *Choristoneura conflictana* (Wlk.). For the second year, tortrix populations remained high. In 1979, surveys detected almost total defoliation of quaking aspen of 26,771 acres; an increase of 5,651 acres (21 percent) over the area defoliated in 1978. The majority of the infestation is still located

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Willows defoliated by willow leaf miner.

approximately 8 miles west-southwest of Willow. An additional area of light to moderate defoliation was observed west of the confluence of the Yentna and Susitna Rivers. Tortrix populations increased in both the Anchorage Bowl and interior aspen forests. However, defoliation still remains light in these areas. Surveys near Willow in the spring and fall of 1979 indicated that 16 percent of the aspen died and 16 percent were top-killed as a result of 3 to 4 consecutive years of 90 percent-plus defoliation.

Leaf rollers, *Epinotia solandriana* L. Populations of this defoliator decreased to endemic levels. No visible defoliation was detected during 1979 aerial surveys in comparison to the 14,749 acres detected in 1978.

Aspen blotch miner, *Lithocolletis ontario* (Free.). Populations of aspen blotch miners dramatically decreased from the 516,436 acres aerially detected in 1977 and 1978. No visible defoliation was detected during 1979 aerial surveys.

Western black-headed budworm, *Acleris gloverana* (Weshm). Black-headed budworm populations continued to remain at endemic levels throughout southeast Alaska in 1979. Defoliation was visible from the air in only one location — Hecata Island (located west of Prince of Wales Island; south of Kosciusko Island). Approximately 247 acres of western hemlock were moderately defoliated in two patches bordering Cone Bay on the west side of the island. Despite considerable browning of the upper crowns, little top-kill or whole-tree mortality is expected to result from this year's defoliation. Larval counts taken during the annual permanent plot defoliator survey showed that budworm populations were lower than in 1978, but larvae were collected in more locations. Populations at Calder Bay were comparable to 1978 levels, but declined considerably in Tuxekan (northern Prince of Wales Island). The western black-headed budworm is expected to remain at endemic levels in 1980, with possible localized buildups in the northwest corner of Prince of Wales Island and Kosciusko Island.

Hemlock sawfly, *Neodiprion tsugae* (Midd.). Hemlock sawfly populations remained endemic in 1979, with no defoliation visible from the air. A slight upward population trend was observed, as larvae were collected from nearly one-third of the 84 sampling points throughout southeast Alaska's hemlock forests. Larval counts, although low, were the highest since 1975, and may increase further in 1980.

Saddleback looper, *Ectropis crepuscularia* (Denis & Schiff.). For the second consecutive year, saddleback looper populations increased, attaining their highest levels in 10 years. Larvae were collected in nearly half the 84 permanent sampling locations, including three plots north of Frederick Sound. This defoliator still remains endemic; however, populations may continue to increase, representing a potential threat to western hemlock in the southeast.

Other loopers. Other geometrid larvae associated with western hemlock in 1979 included the green-striped forest looper (*Melanolophia imitata* (Walker)), the Columbia brindle looper *(Anthelia hyperborea),* and *Hydriomena irata.* All three defoliators were found in low numbers during the larval survey, but were widely distributed. The green-striped and Columbia brindle loopers were collected mostly south of Frederick Sound, while *Hydriomena* occurred from Lynn Canal south throughout the north half of Prince of Wales Island. In general, these looper populations are expected to remain endemic.

Hardwood defoliation. Hardwood defoliation from unknown causes covered approximately 39,437 acres. The majority of the defoliation was scattered throughout Alaska's interior hardwood forests. Moderately to heavily defoliated balsam poplars (approximately 12,029 acres) were detected from Kashwitna Lake south to the confluence of the Yentna and Susitna Rivers. An additional 9,654 acres of defoliated willow and poplar were detected along the Yukon River near the village of Beaver. Likewise, 4,645 acres of defoliated willow and poplar were observed west and northwest of Fort Yukon along the Yukon and Porcupine Rivers.

If this defoliation continues next year, ground evaluations will be undertaken to determine the causal agent(s).

Status of Diseases

Hemlock dwarf mistletoe, *Arceuthobium tsugense* (Rosend.) G. N. Jones, remained the most damaging tree disease in southeast Alaska. A high percentage of old growth stands between Haines and Ketchikan were infected.

Spruce needle rust, *Chrysomyxa ledicola* Lagh. Approximately 66,717 acres of needle rust were detected in 1979. The severe 1978 outbreak located northwest and east of Ruby declined by more than 50 percent. The scattered rust damage located in 1978 along the upper Porcupine River was not detected in 1979.

A substantial increase in needle rust was observed on the Kenai Peninsula. In 1979, 40,403 acres of rust-infected white spruce were detected versus 618 acres in 1978. Up to 90 percent of the current year's needles on all age classes of white spruce were infected. The largest area of infection extended from Clam Gulch south to the village of Ninilchik. Two consecutive warm and wet summers undoubtedly contributed to this increase in needle rust activity. If the 1980 summer weather patterns follow those of 1978 and 1979, there may be a serious effect on the following year's growth.

Likewise, spruce needle rust was prevalent throughout southwest Alaska. Infected trees were highly visible from King Salmon to the Lake Clark region.

Sirococcus shoot blight, *Sirococcus strobilinus* Preuss., was found throughout southeast Alaska with epicenters located in western hemlock reproduction at Thomas Bay and Yakutat.

Flood damage. Flooding killed white spruce on 4,670 acres along the Yukon River south of Anvik and on 1,500 acres along the Chichitnak River south of the Taylor Mountains.

Forest Insect and Disease Management Publications

Northern Region (R-1)

Bennett, D.D.
1979. Pilot survey to measure annual mortality caused by mountain pine beetle in lodgepole pine on the Beaverhead, Gallatin, and Flathead Forests in 1978. Report 79-12.

Bennette, D.D., and W. E. Bousfield.
1979. A pilot survey to measure annual mortality by mountain pine beetle. Report 79-20.

Bousfield, W.E.
1979. R-1 forest insect and disease damage survey system. Report 79-2

Bousfield, W.E.
1979. Progress report on spruce budworm damage in Idaho and Montana, 1978. Report 79-11.

Bousfield, W.E., and G.C. Franc.
1979. Remeasurement of western spruce budworm damage areas on the Clearwater National Forest, Idaho, 1978. Report 79-8.

Carlson, C.E., C.C. Gordon, and C.J. Gilligan.
1979. The relationship of fluoride to visible growth/health characteristics of *Pinus monticola, Pinus contorta,* and*Pseudotsuga menziesii.* Fluoride 12/1:9-17.

Dewey, J.E., and M.J. Jenkins.
1979. An evaluation of cone and seed insects in selected seed production areas in Region 1 (Progress report). Report 79-16.

Dooling, O.J.
1979. Evaluation of a proposed dwarf mistletoe management project on the Sula Ranger District, Bitterroot National Forest. Report 79-17.

Dooling, O.J.
1979. Dwarf mistletoe loss assessment in east side Northern Region National Forest. Report 79-13.

Flavell, Thomas H.
1979. Reevaluation of larch casebearer parasites in casebearer-infested stands of Region 1. Report 79-3.

Gibson, K.E., and D.D. Bennett.
1979. Overwintering survival of mountain pine beetle larvae and resultant effects on beetle populations in the Northern Region in 1979. Report 79-15.

Gibson, K.E., and M.M. McGregor.
1979. Potential for mountain pine beetle infestation on the Tally Lake Ranger District, Flathead National Forest, Montana. Report 79-5.

Gibson, K.E., M.M. McGregor, and D.D. Bennett.
1979. An evaluation of a developing mountain pine beetle infestation in Centennial Valley, Montana, 1979. Report 79-19.

Gibson, K.E., H.E. Meyer, and D.D. Bennett.
1979. Mountain pine beetle infestation potential for the Plains Ranger District, Lolo National Forest. Report 79-9.

Hard, J.S.
1979. A reevaluation of 1978 *Bacillus thuringiensis* applications for cankerworm control in Siberian elm shelterbelts. Report 79-18.

Hard, John, Richard Frye, Donald Carey, and Mary Ellen Dix.
1979. An evaluation of day and night aerial *B.t.* applications for cankerworm control in Siberian elm shelterbelts. Not numbered.

Hard, John S., and John Rice.
1979. Preliminary results of seedling damage survey in young plantations on selected forests in Region 1. Report 79-10.

McGregor, M.D.
1979. A demonstration of lodgepole pine management to prevent mountain pine beetle outbreaks— Yaak and Thompson River drainages. Progress report. Report 79-14.

McGregor, M.D., D.D. Bennett, and H.E. Meyer.
1979. Evaluation of mountain pine beetle infestation, Hebten Lake Ranger District, Gallatin National Forest, Montana, 1978. Report 79-6.

McGregor, M.D., and K.E. Gibson.
1979. Evaluation of the mountain pine beetle infestation, Blackfeet Indian Reservation and East Side Glacier National Park, Montana 1979. Report 79-21.

McGregor, M.D., K.E. Gibson, and D.D. Bennett.
1979. Bark beetle conditions, Northern Region, 1978. Report 79-4.

Robinson, Laird A., Jerald E. Dewey, and Clinton E. Carlson.
1979. Forest insect and disease conditions in the Northern Region, 1978. Report R1-79-17.

Walsh, Natalie, and Gael Bissell.
1979. Impact of copper smelter emissions on two subalpine ecosystems near Anaconda, Montana. Report 79-7.

Gillman, L.S.
1979. Wild Mushrooms - enjoy them in your National Forests and National Grasslands of the Rocky Mountain Region. Publication 1-22-5-79. 29 p.
Hildebrand, D.M.
1979. Mycorrhizal inoculation of container-grown Engelmann spruce and lodgepole pine. Technical Report R2-18. 24 p.
James, R.L.
1979. An evaluation of *Diplodia pinea* on Austrian pine seedlings at Bessey Nursery, Nebraska. Biological Evaluation R2-79-1. 5 p.
James, R.L.
1979. Lodgepole pine seedling chlorosis and mortality at Bessey Nursery, Nebraska. Biological Evaluation R2-79-2. 10 p.
James, R.L.
1979. Leafspot of silver maple seedlings at Bessey Nursery, Nebraska. Biological Evaluation R2-79-3. 6 p.
James, R.L.
1979. Jack pine decline in the Nebraska National Forest: distribution, insect and fungal associates. Biological Evaluation R2-79-4. 19 p.
James, R.L.
1979. Fungi associated with mortality of containerized Austrian pine seedlings at the Kansas State and Extension Forestry Greenhouse. Biological Evaluation R2-79-7. 11 p.
James. R.L.
1979. An evaluation of Engelmann spruce seedling tip dieback at Bessey Nursery, Nebraska. Biological Evaluation R2-79-9. 5 p.
James, R.L.
1979. Winter damage to ponderosa pine in Nebraska. Biological Evaluation R2-79-13. 9 p.
James, R.L.
1979. Fomes annosus on white fir in Colorado. Plant Disease Reporter 63:129-130.
James, R.L. and L.S. Gillman.
1979. Fomes annosus on white fir in Colorado. Technical Report R2-17. 9 p.
James, R.L., D.W. Johnson and W.G. Telfer.
1979. Diplodia tip blight of ponderosa pine in the Black Hills, South Dakota. Biological Evaluation R2-79-8. 10 p.
James, R.L. and J.P. Linnane.
1979. Forest Insect and Disease Management Annual Report. Rocky Mountain Region, 1978. 51 p.
Johnson, D.W.
1979. Dwarf mistletoe surveys, Bureau of Land Management, Craig District, Kremmling Resource Area, Colorado. Biological Evaluation R2-79-5. 10p.
Johnson, D.W.
1979. Examination of Bessey Nursery stock for western gall rust, Nebraska. Biological Evaluation R2-79-6. 2 p.
Johnson, D.W.
1979. Growth and fate of comandra rust cankers on young lodgepole pine. Technical Report R2-19. 10p.
Johnson, D.W.
1979. Growth and development of comandra rust cankers on young lodepole pine. Plant Disease Reporter. 63:916-918.
Johnson, D.W., F.G. Hawksworth and D. B. Drum-
1979. 1978 dwarf mistletoe loss assessment survey. Bighorn and Shoshone National Forests, Wyoming. 79-3. 8 p.
Johnson, D.W. and J.E. Kuntz.
1979. Eutypella canker of maple: ascospore discharge and dissemination. Phytopathology 69:130-135.
Johnson, D.W. and J.E. Kuntz.
1979. *Eutypella parasitica:* ascospore germination and mycelial growth. Canadian Journal of Botany 57:624-628.
Lessard, G.D.
1979. Mountain pine beetle, Project #632, Progress Report, Black Hills National Forest. Biological Evaluation R2-79-11. 9 p.
Lessard, G.D.
1979. Mountain pine beetle, Bear Lodge Mountains, Black Hills National Forest. Biological Evaluation R2-79-12. 7 p.
Lessard, G.D.
1979. Mountain pine beetle evaluation, South Dakota State Cooperative Area - 1979, Progress Report #1. Biological Evaluation R2-79-15. 9 p.
Linnane, J.P.
1979. Western tent caterpillar, Pagosa Ranger District, San Juan National Forest. Biological Evaluation R2-79-10. 9 p.
Linnane, J.P.
1979. Western spruce budworm results of an egg mass survey on the Pike and San Isabel, and Arapaho and Roosevelt National Forests in 1979. Biological Evaluation R2-79-14. 16 p.
Stevens, R.E., C.K. Lister, and J.P. Linnane.
1979. Outbreak of a twig beetle, *Pityophthorus opaculus* LeConte, in Colorado. Coleopterists Bulletin 33(3):268.

Southwestern Region (R-3)

Hofacker, T. H., D.G. Holland, and T. Smith.
1979. 1978 Cooperative Douglas-fir tussock moth NPV pilot control project. County of Los Alamos, New Mexico. R-3 79-6.

Parker, D.L.
1979. Integrated pest management guide: Arizona five-spined ips, *Ips lecontei* Swaine, in ponderosa pine. R-3 79-79.

Parker, D.L., and R.E. Stevens.
1979. Mountain pine beetle infestation characteristics in ponderosa pine, Kaibab Plateau, Arizona, 1975-1977. Research Note RM-367.

Ragenovich, I.R.
1979. Western tent caterpillar in aspen. R-3 79-9.

Intermountain Region (R-4)

Barry, W.B., G.P. Markin, J.A.E. Knopf, and J. Wong.
1979. Demonstration of the Marsh Turbo Thrush to deliver pesticides to coniferous forests. Donnelly, Idaho.

Beveridge, Ron, and Max M. Ollieu.
1979. Impact of defoliation by western spruce budworm. Boise and Payette National Forests, other Federal, State and private lands.

Hoffman, J.T.
1979. Biological evaluation of the Old Smokey Campground, Payette National Forest.

Hoffman, J.T., and L. Hobbs.
1979. Dwarf mistletoe loss assessment survey in Region 4, 1978. R-4-79-4.

Hoffman, J.T., and G.M. Filip.
1979. Biological Evaluation of root rot of spruce, Peterson Grove, Dixie National Forest.

Hoffman, J.T., and R.E. Wood.
1979. Biological evaluation of *Macrophomina phaseoli* at the Lucky Peak Nursery, Boise National Forest.

Hoffman, J.T., and A.C. Tegethoff.
1979. 1978 Dwarf mistletoe presuppression survey on the Payette National Forest.

Knopf, Jerry A.E.
1979. Calf Pen and Paradise Flat timber sales, *Ips* management, Council Ranger District.

Knopf, Jerry A.E.
1979. Protection from *Ips* buildup for Little Beaver S&S timber sale, Idaho City Ranger District.

Knopf, Jerry A.E.
1979. *Ips* management, Summit Gulch timber sale, Council Ranger District.

Knopf, Jerry A.E.
1979. Bark beetle and disease management, proposed Rainbow Helicopter timber sale, Krassel Ranger District.

Knopf, Jerry A.E.
1979. Beetle evaluation, timber trespass. North Fork Ranger District, Salmon National Forest.

Knopf, Jerry A.E.
1979. *Ips* management, Calf Pen timber sale, Council Ranger District.

Knopf, Jerry A.E.
1979. Beetle evaluation, illegal felling of ponderosa pine adjacent to the Dave Jerome Ranch. Emmett Ranger District.

Knopf, Jerry A.E.
1979. Pre-sale *Ips* evaluation, Cow Camp timber sale. Emmett Ranger District.

Knopf, Jerry A.E.
1979. *Ips* management, early entry into Dry Buck thinning sale. Mountain Home Ranger District.

Knopf, Jerry A.E., G.P. Markin, P.J. Shea, and W.M. Ciesla.
1979. Western spruce budworm population densities and defoliation 1 year after insecticide treatment of small blocks. New Meadows Ranger District.

Knopf, Jerry A.E., R.L. Beveridge, and A.C. Valcarce.
1979. Biological evaluation, western spruce budworm, Boise and Payette National Forests.

Ollieu, M.M.
1979. Insect and disease evaluation, Bryce Canyon National Park.

Ollieu, M.M.
1979. FI&DM recommendations - proposed Stewart Creek timber sale. Fairfield Ranger District.

Oliieu, M.M.
1979. FI&DM review of Dixie National Forest developed sites.

Ollieu, M.M.
1979. Bark beetle buildups in Council area, Payette National Forest.

Ollieu, M.M.
1979. FI&DM input in proposed Fleck Summit timber sale. Fairfield Ranger District.

Ollieu, M.M.
1979. FI&DM input, Barker Gulch timber sale. Fairfield Ranger District.

Ollieu, M.M.
1979. Forest entomology input into Little Salmon Planning Unit, Bureau of Land Management. New Meadows, Idaho.
Thier, Ralph T., and Ronald L. Beveridge.
1979. Biological evaluation, bark beetle infestation. Escalante Ranger District.
Valcarce, A.C.
1979. Evaluation of Town Creek thinning, pine engraver beetle, Boise National Forest.
Valcarce, A.C.
1979. Pine engraver beetle management. Gill Springs timber sale, Emmett Ranger District.
Valcarce, A.C.
1979. *Ips* and gall rust management. Jakie Creek and Poverty Burn plantings. Krassel Ranger District.
Valcarce, A.C.
1979. FI&DM input, proposed Saddle and Bird timber sales. New Meadows Ranger District.
Valcarce, A.C.
1979. FI&DM input, proposed Abbott Gulch timber sale, Fairfield Ranger District.
Valcarce, A.C.
1979. Pine engraver beetle management, proposed Dutch Ceek timber sale. New Meadows Ranger District.
Valcarce, A.C.
1979. *Ips* management, West Fork Face sale. New Meadows Ranger District.
Valcarce. A.C.
1979. Mountain pine beetle control recommendations, individual trees. Caribou National Forest.
Valcarce, A.C.
1979. Pine engraver beetle management, Woodard Gulch sale, Emmett Ranger District.
Valcarce, A.C.
1979. Biological control - larch casebearer. 1978. Release of *Agathis pumila* in R-4.
Valcarce, A.C.
1979. Ips management. Second Fork precommercial thinning. Emmett Ranger District.
Valcarce, A.C.
1979. Bark beetle management. Proposed Johnson 'Copter timber sale. Mountain Home Ranger District.
Valcarce, A.C.
1979. *Ips* management. Seid Creek timber sale. Weiser Ranger District
Valcarce, A.C., and Hoffman, J.T.
1979. Biological evaluation, mountain pine beetle, dwarf mistletoe and broom rust on the Twin Falls Ranger District.

Pacific Southwest Region (R-5)

Arciero, M., P. Svihra, and J. Pronos.
1979. Federal Dutch elm disease control program in California — 1979 progress report.
Byler, J.W., F.W. Cobb, Jr., and D.L. Rowney.
1979. An evaluation of black stain root disease on the Georgetown Divide, El Dorado County, California. Report 79-2. 15 p.
Byler, J.W., and J.R. Parmeter, Jr.
1979. An evaluation of white pine blister rust in the Sierra Nevada. Report 79-3. 19 p.
California Forest Pest Control Action Council.
1979. Forest pest conditions in California — 1979. A joint publication of the California Forest Pest Control Action Council; USDA, Forest Service, Pacific Southwest Region, Forest Insect and Disease Management; and the California Department of Forestry. Sacramento, California. 20 p.
Caylor, J.A.
1979. High altitude reconnaissance photography — a novel data source facilitates salvage of drought related tree mortality in northern California. Western Society of Naturalists, 60th Annual Meeting, California Polytechnic University, San Luis Obispo, 26 December 1979 (Abstr.).
Caylor, J.A. and J.R. Pierce.
1979. U-2 optical bar photography — training notes.
Dahlsten, D.L., N.X. Norick, J.M. Wenz, and C.B. Williams, Jr.
1979. Evaluation of sparse Douglas-fir tussock moth populations. California Agriculture 33:26-27.
Dale, J.W.
1979. Biological evaluation of Douglas-fir cone midge damage at Badger Hill Breeding Arboretum.
Dale, J.W.
1979. Update — proposed Sugarleaf salvage of trees killed by bark beetles, Bald Rock (RARE II Area No. 5169) and Middle Fork of the Feather River (RARE II Area No. 5167), Plumas National Forest.
Hart, D.R.
1979. Biological evaluation — Timbered Sale, Modoc National Forest.
Pierce, J.R.
1979. Biological evaluation on Indian Ridge, Trabuco Ranger District, Cleveland National Forest.
Pierce, J.R.
1979. Insect evaluation on Eagle Lake Ranger District, Lassen National Forest.
Pierce, J.R.
1979. Insect evaluation — Little Horse Peak Timber Sale, Klamath National Forest.
Pierce, J.R.
1979. Insect evaluation, Plumas National Forest.

Pierce, J.R.
1979. Insect evaluation, La Porte Ranger District, Plumas National Forest.
Pierce, J.R., J.W. Dale, and D.E. Schultz.
1979. Cooperative Forest Service— California Department of Forestry aerial survey of current tree mortality in the Sierra Nevada.
Pronos. J., and J.W. Dale.
1979. Biological evaluation on Hume Lake Ranger District, Sequoia National Forest.
Pronos, J., and D.E. Schultz.
1979. Biological evaluation of Mammoth and Mono Lake Ranger Districts. Inyo National Forest.
Pronos, J., and D.R. Vogler.
1979. Annual evaluation of air pollution injury in the southern Sierra Nevada.
Roettgering, B.H., and J. Pronos.
1979. Biological evaluation on Pineridge Ranger District. Sierra National Forest.
Roettgering B.H., and M.D. Srago.
1979. Polk Springs biological evaluation update (RARE II Area No. 5097).
Schultz, D.E., and J.W. Byler.
1979. A biological evaluation of mortality on Mad River Ranger District, Six Rivers National Forest.
Schultz, D.E., and J.W. Dale.
1979. Biological evaluation of infestation of black pine-leaf needle scale at Badgert Hill Breeding Arboretum.
Schultz, D.E., and J. Pronos.
1979. Examination of tree improvement program progeny outplanting sites, Stanislaus National Forest.
Smith, R.S., Jr.
1979. Biological evaluation of tree mortality in Big Canyon and West Break Sale Areas, Shasta-Trinity National Forest.
Smith, R.S., Jr.
1979. Evaluation of the Sweet Pea Sale, Sierra National Forest.
Smith, R.S., Jr.
1979. Tree hazard evaluation, Shasta-Trinity National Forest.
Smith, R.S., Jr.
1979. Tree hazard evaluation of Tannery Gulch Recreation Area, Shasta-Trinity National Forest.
Smith, R.S., Jr., and J.R. Pierce.
1979. Evaluation of mortality of true fir in a salvage sale area on the Sierra National Forest.
Srago, M.D.
1979. Biological evaluation of Burgess and Harvey Timber Sales, Lassen National Forest.
Srago, M.D.
1979. Biological evaluation of Indian Ridge, Cleveland National Forest.
Srago, M.D.
1979. Biological evaluation of the proposed Laguna Mountain entrance site.
Srago, M.D.
1979. Biological evaluation of seedling losses caused by water mold fungi at Placerville Nursery.
Srago, M.D.
1979. *Fomes annosus* in the Ice Cave Timber Sale.
Srago, M.D.
1979. Persistent diseases at Placerville Nursery.
Srago, M.D.
1979. Update on salt damage to roadside vegetation, Lake Tahoe Basin Management Unit.
Vogler, D.R.
1979. Examination of ozone injury to pines near South Lake Tahoe, Lake Tahoe Basin Management Unit.
Wenz, J.M.
1979. Tent caterpillar on bitterbrush, Mono Lake Ranger District, Inyo National Forest.
Williams, C.B., Jr., J.M. Wenz, D.L. Dahlsten, and N.X. Norick.
1979. Relation of forest site and stand characteristics to Douglas-fir tussock moth (Lep. Lymantriidae) outbreaks in California. Bull. De La Societe Entomologique Suisse 52:297-307.
Wood, R.E., and D.E. Schultz.
1979. Dwarf mistletoe control in the Big Bear North Shore Recreation Area.
Wood, R.E., and D.E. Schultz.
1979. *Fomes annosus* in Big Bear Lake North Shore Development Area.
Wood, R.E., M.J. Schuft, and D.E. Schultz.
1979. An evaluation of tree mortality in Laguna Mountain Recreation Area. Cleveland National Forest. Report No. 79-1. 22 p.

Pacific Northwest Region (R-6)

Anderson, Ullrich, Roth, Filip.
1979. October. Genetic identification of clones of *Armillaria mellea* in coniferous forests in Washington. Phytopathology.
Bridgewater, David R.
1979. Biological evaluation mountain pine beetle, Lemolo Lake Area, Umpqua National Forest.
Bridgewater, David R.
1979. Biological evaluation mountain pine beetle, Diamond Lake, Umpqua National Forest.
Bridgewater, David R.
1979. Biological evaluation larch looper, Colville National Forest, October 1978.

Bridgewater, D.R., T.F. Gregg, and J.S. Hadfield.
1979. Forest insect and disease conditions in the Pacific Northwest 1978.
Dolph, Robert E.
1979. Mountain pine beetle - lodgepole pine on Republic and Kettle Falls Ranger Districts, Colville National Forest.
Dolph, Robert E.
1979. Mountain pine beetle - lodgepole pine at Sheep Bridge Campground, Bend Ranger District, Deschutes National Forest.
Dolph, Robert E.
1979. Bark beetle evaluation on the Lakeview, Bly and Paisley Ranger Districts, Fremont National Forest.
Dolph, Robert E.
1979. Bark beetle evaluation in a fire area on the Snow Mountain Ranger District, Ochoco National Forest.
Dolph, Robert E.
1979. Bark beetle evaluation in a fire area on the Bend Ranger District, Deschutes National Forest.
Dolph, Robert E.
1979. Western pine beetle evaluation on the Klamath Falls Ranger District, Winema National Forest.
Filip, Gregory M.
1979. Root disease evaluation, Tieton Ranger District, Wenatchee National Forest and Sisters Ranger District, Deschutes National Forest, June.
Filip, Gregory M.
1979. Root disease evaluation, Sisters Ranger District, Deschutes National Forest, June.
Filip, Gregory M.
1979. Location, extent, and cause of tree mortality in a mixed-conifer forest on the Kettle Falls Ranger District, Colville National Forest, Washington, February.
Filip, Gregory M.
1979. Plantation evaluation for root disease, Packwood Ranger District, Cifford Pinchot National Forest, June.
Filip, Gregory M.
1979. Root disease evaluation, Fremont National Forest, August.
Filip, Gregory M.
1979. Seed production and evaluation plantation site evaluation, Tieton Ranger District, Wenatchee National Forest, September.
Filip, Gregory M.
1979. Annual progress report: effect of precommercial thinning in Armillaria-infected Douglas-fir plantations on the Blue River Ranger District, Willamette National Forest, September.
Filip, Gregory M.
1979. Progress report: effect of precommercial thinning in Armillaris-infected ponderosa pine plantations on the Sisters Ranger District, Deschutes National Forest, September.
Filip, Gregory M.
1979. Evaluation, Rogue River National Forest, November 1978.
Filip, Gregory M.
1979. Hazard tree evaluation, Mt. Hood National Forest, October 1978.
Filip, Gregory M.
1979. Dorena Tree Improvement Center, Umpqua National Forest, October 1978.
Filip, Gregory M., and David R. Bridgwater.
1979. Colville Ranger District campground evaluation, Colville National Forest, October 1978.
Filip, Gregory M., and Stanley W. Meso.
1979. Seed production site evaluation, Randle and Mt. Adams Ranger District, Gifford Pinchot National Forest, December 1978.
Filip, Gregory M., and Paul E. Aho.
1979. Incidence of wounding and associated stain and decay in advanced white fir regeneration on the Fremont National Forest, November 1978.
Filip, Gregory M., James S. Hadfield, and Craig L. Schmitt.
1979. March. Branch mortality of true firs in west-central Oregon associated with dwarf mistletoe and canker fungi. Plant Disease Reporter.
Filip, Gregory M., and Craig L. Schmitt
1979. June. Susceptibility of native conifers to laminated root rot east of the Cascade Range in Oregon and Washington. Forest Science.
Filip, Gregory M.
1979. July. Root disease in Douglas-fir plantations is associated with infected stumps. Plant Disease Reporter.
Goheen, Donald J.
1979. Root disease evaluation on the Medford District, Bureau of Land Management, March 20-22.
Goheen, Donald J.
1979. Root disease evaluation of Two-Dog Creek and Dome Creek Units, Rigdon Ranger District, Willamette National Forest.
Goheen, Donald J.
1979. Root disease-mistletoe evaluation of the Diorite Timber Sale, Clackamas District, Mt. Hood National Forest.
Gregg, J., J. Wortendyre, D. Twardus, and J. Wear.
1979. 1976 Western spruce budworm loss assessment survey, north-central Washington.
Hadfield, James S.
1979. March 23. Dwarf mistletoe evaluation - Baker River District, Mt. Baker-Snoqualmie National Forest.
Hadfield, James S.
1979. May 8. Nursery disease evaluations - Medford Forest Nursery, Rogue River National Forest.
Hadfield, James S.
1979. May 22. Nursery disease evaluations - Medford Forest Nursery, Rogue River National Forest.

Hadfield, James S.
1979. May 22. Plantation damage evaluation - Lowell District, Willamette National Forest.

Hadfield, James S.
1979. June 7. Hazard tree evaluations - Olympic National Park.

Hadfield, James S.
1979. July 26. Dwarf mistletoe evaluations - Colville National Forest.

Hadfield, James S.
1979. August 21. Hazard tree evaluations - Whitman Mission National Historic Site.

Hadfield, James S.
1979. August 27. Dwarf mistletoe evaluation - Long Creek District, Malheur National Forest.

Hadfield, James S.
1979. September 24. Laminated root-rot evaluation - Quilcene District, Olympic National Forest.

Harvey, Robert D., Jr.
1979. Rate of increase of blue stained volume in mountain pine beetle-killed lodgepole pine in Northeastern Oregon, USA. Canadian Journal of Forest Research 9(3):323-326.

Harvey, Robert D., Jr.
1979. Fungi isolated from within Oregon and Washington spruce seed. Office Report, 6 pp.

Lane, B.B., and D. J. Goheen.
1979. Incidence of root disease in bark beetle-infested Eastern Oregon and Washington true firs. Plant Disease Reporter 63:262-266.

McComb, David.
1979. Evaluation of western spruce budworm. Fall 1978. Okanogan National Forest and North Cascades National Park.

Pettinger, Leon F. and R.L. Johnsey.
1979. Results of surveys in Northeast Washington during 1977 and 1978 for introduced exotic and native hymenopterous parasites of the larch casebearer.

Southern Region (R-8)

Affeltranger, C.E.
1979. Control of fusiform rust in a slash pine outplanting with a systemic fungicide. Report No. 79-2-9.

Affeltranger, C.E.
1979. Volume loss caused by fusiform rust in slash pine plantations in Central Louisiana - final report. Report No. 79-2-10.

Affeltranger, C.E.
1979. Sampling theory and procedures for nursery pest problems. 1 p.

Anderson, Robert L., Tom Gentry, and Kris Johnson.
1979. Distribution, incidence and damage caused by the pitch canker fungus on slash and long leaf pine, Apalachicola National Forest, Florida - 1978. Report 79-1-1.

Anderson, Robert L., William Hoffard, and Vickie Fisher
1979. Potential walnut problem - Edwards State Nursery. Report No. 79-1-3.

Anderson, Robert L.
1979. Letter to Ralph C. Winkworth concerning foliage blight and root rot at Edwards Nursery. Report 79-1-15.

Anderson, Robert L., and Patrick J. Barry.
1979. Evaluation of potential insect and disease problems at the Cradle of Forestry Demonstration Nursery, Brevard, NC, 1979. Report No. 79-1-26.

Anderson, Robert L., Patrick J. Barry and William H. Hoffard.
1979. Evaluation of disease and insect problems in eucalyptus experimental and field plantings. Report No. 79-1-32.

Anderson, Robert L.
1979. Oak decline on the Wayah Ranger District, Nantahala National Forest, NC, 1979. Report No. 79-1-37.

Anderson, Robert L.
1979. Selected publications on decay in eastern hardwoods. Report No. 79-1-38.

Anderson, R. L., and S. A. Alexander.
1979. "How to Identify and Control White Pine Root Decline."

Anderson, R.L., and P.J. Barry
1979. Identify bud blast and twig blight of rhododendron.

Anderson, R.L., and C.E. Cordell.
1979. Recognize and quantify ecto-mycorrhizae on conifers.

Anderson, R.L..
1979. Mycorrhizae: descriptions, benefits, and applications in forest tree nurseries. 5 p.

Anderson, R.L., and D.G. Mosher.
1979. Lakeshore effects on nectria canker of yellow birch. Journal of Forestry. 77:412-413.

Barber, Larry R., and Donna Leonard.
1979. Spray evaluation of two International Paper Company seed orchards. December 1978 - January 1979. Report No. 79-1-11.

Barber, Larry R..
1979. Male peach tree borer pheromone trap catches at two locations, Asheville and Murphy, NC - 1978. Report No. 79-1-14.

Barber, Larry R.
1979. Evaluation of two carbofuran soil incorporating systems. Report No. 79-1-17.

Barry, Patrick J.
1979. Jumping Branch Fire, Andrew Pickens Ranger District, Francis Marion and Sumter National Forests, insect and disease evaluation. Report No. 79-1-2.
Barber, Larry R., Donna Leonard, Don Roberts, and Harvey Barron.
1979. An evaluation of white pine cone beetle cone losses on the Edwards Seed Orchard, Morganton, NC. Report No. 79-1-36.
Barry, Patrick J., and William H. Hoffard.
1979. Biological evaluation of the introduced pine sawfly outbreak in the Linville Falls area of the Blue Ridge Parkway, North Carolina. Report No. 79-1-9.
Barry, Patrick J., and Ted Oprean.
1979. Evaluation of balsam wooly aphid on Roan Mountain, Toecane Ranger District, Pisgah National Forest, NC. Report No. 79-1-12.
Bassett, R.F.
1979. Report of aerial detection survey: U.S. Department of the Interior, National Park Service, Chickamagua and Chattanooga National Military Park. Report No. 79-3-4.
Bassett, R.F., and R. Ruiddlehoover.
1979. Report of aerial detection survey: Long Cane Ranger District, Sumter National Forest, South Carolina. Report No. 79-3-9.
Bassett, R.F., M. Farley, and B. Lake.
1979. Report of aerial detection survey: Tyger Ranger District and Enoree Ranger District, Sumter National Forest, South Carolina. Report No. 79-3-10.
Bassett, R.F., and J. Blair.
1979. Report of aerial detection survey: Andrew Pickens Ranger District, Sumter National Forest, S.C.. Report No. 79-3-11.
Bassett, R.F., and H. West.
1979. Report of aerial detection survey: Edgefield Ranger District, Sumter National Forest, S.C. Report No. 79-3-12.
Bassett, R.F., S. Ford, and G. Forte.
1979. Report of aerial detection survey: Francis Marion National Forest, S.C. Report No. 79-3-15.
Bassett, R.F., and D. Stevens.
1979. Report of aerial detection survey: Talladega Ranger District, Talladega National Forest, Alabama. Report No. 79-3-26.
Bassett, R.F., T. Pettifield, and K. Barker.
1979. Report of aerial detection survey: Shoal Creek Ranger District, Talladega National Forest, Alabama. Report No. 79-3-27.
Bassett, R.F., and D. Wallace.
1979. Report of aerial detection survey: Oakmulgee Ranger District, Talladega National Forest, Alabama. Report No. 79-3-28.
Bassett, R.F., T.P. Russell, and J.L. Wehry.
1979. Report of aerial detection survey: Black Warrior and Bankhead Ranger Districts of the W. B. Bankhead National Forest, Alabama. Report No. 79-3-30.
Bassett, R.F., T.P. Russell, and G.A. Autry.
1979. Report of aerial detection survey: forest insect and disease activity Choctaw Ranger District and Tiak Ranger District, Ouachita National Forest, Oklahoma. Report No. 79-3-31.
Bassett, R.F., R. Allen and J. Carter.
1979. Report of aerial detection survey of forest insect and disease activity, Andrew Pickens Ranger District, Sumter National Forest, S.C. Report No. 79-3-39.
Bowling, Kim D., Vicki Fisher, Robert L. Anderson, and Joel D. Artman.
1979. White pine blister rust evaluation - Shenandoah National Park. Report No. 79-1-46.
Carothers, W.A., R.F. Bassett, and B.I. Hammond.
1979. Report of aerial detection survey: Oconee National Forest, Piedmont National Wildlife Refuge, and Hitchiti Experimental Forest, Ga. Report No. 79-3-2.
Carothers, W.A., and B.I. Hammond.
1979. Report of aerial detection survey: cottonwood plantations along the Mississippi River, Mississippi, Louisiana and Arkansas. Report No. 79-3-5.
Carothers, W.A., B.I. Hammond, F. Oliveria, and M.L. Garrett.
1979. Report of aerial detection survey: cottonwood plantations along the Mississippi River; Mississippi, Louisiana and Arkansas. Report No. 79-3-6.
Carothers, W.A., R.F. Bassett, C.W. Dull, R. Filar, R. Franklin, and D. Mettheaure.
1979. Report of aerial detection survey: Oconee National Forest, Hitchiti Experimental Forest and Piedmont National Wildlife Refuge, Georgia. Report No. 79-3-7.
Carothers, W.A., J. Beck, and J. Cole.
1979. Report of aerial detection survey: William B. Bankhead National Forest, Alabama. Report No. 79-3-8.
Carothers, W.A., C. Tolley, and J. Ghent.
1979. Report of aerial detection survey: Linville Gorge Wilderness Area (Pisgah National Forest), and surrounding National Forest, State, and private lands, N.C. Report No. 79-3-13.
Carothers, W.A., and B.F. Hammond.
1979. Report of aerial detection survey: Oconee National Forest, Hitchiti Experimental Forest, Piedmont National Wildlife Refuge, Georgia. Report No. 79-3-16.
Carothers, W.A., and B.I. Hammond.
1979. Report of aerial detection survey: Delta National Forest, Mississippi. Report No. 79-3-34.
Carothers, W.A., and B.I. Hammond.
1979. Aerial detection survey of forest insect and disease activity, Tombigbee National Forest (Tombigbee Ranger District, Trace and Grenada Units). Report No. 79-3-35.

Carothers, W.A., T.F. Buckner, T.P. Russell, D. Parks, and M. Haralson.
1979. Aerial detection survey of forest insect and disease activity, Chatahoochee River National Recreation Area. Report No. 79-3-36.
Cordell, C.E.
1979. Effective soil fumigation. 8 p.
Cordell, C.E.
1979. Integrated control for nursery pest management. 9 p.
Cordell, C.E., and D.H. Marx.
1979. National pisolithus tinctorius ectomycorrhizae nursery evaluation results— 1978. 6 p.
Cordell, C.E., R.L. Anderson, and D.H. Marx.
1979. National pisolithus tinctorius ectomycorrhizae nursery evaluation. USDA, For. Serv. Tech. Publ. SA-TP6:97-103.
Clerke, W.H., and J.D. Ward.
1979. Estimating tree mortality over extensive areas. *In* Symposium on Evaluating Control Tactics for the Southern Pine Beetle Proceedings. USDA, For. Serv. Tech. Bul. 1613:75-85.
Dull, C.W., B.I. Hammond, and K. Wooster.
1979. Report of aerial detection survey: Oconee National Forest, Hitchiti Experimental Forest, Georgia. Report No. 79-3-1.
Dull, C.W., and R.F. Bassett.
1979. Report of aerial detection survey: Copiah, Jasper, Newton, Rankin, Scott, Sampson, and Smith Counties, Mississippi. Report No. 79-3-3.
Dull, C.W.
1979. Report of aerial detection survey : detection of forest insect activity on the Shenandoah National Park, Va. Report No. 79-3-22.
Dull, C.W., C. Morris, and J. Pugh.
1979. Report of aerial detection survey in Northern Virginia. Report No., 79-3-23.
Dull, C.W., J. Roberts, C. Morris, D. Collins, G. Oakleaf, and K. Swisher.
1979. Results of detection surveys for forest insect and disease activity on the George Washington National Forest, Virginia and West Virginia. Report No. 79-3-24.
Dull, C.W., T.P. Russell, B. Scott, M. Blackburn, and D. Spiller.
1979. Report of aerial detection survey: Jefferson National Forest, Virginia. Report No. 79-3-25.
Dull, C.W., and W.H. Clerke.
1979. Development of Loran-C Navigation System applications for southern pine beetle survey flightline navigation, ground crew navigation, and spot position determination. 9/1/78 - 1/31/79.
Ghent, John H.
1979. Evaluation of southern pine beetle status on the Chickamagua and Chattanooga National Military Park. Report No. 79-1-8.
Ghent, John H.
1979. An evaluation of Ips status on the Okefenokee National Wildlife Refuge. Report No. 79-1-13.
Ghent, John H., and William H. Hoffard.
1979. 1979 Status of the fall cankerworm on the Cumberland Gap National Historical Park. Report No. 79-1-16.
Ghent, John H., and Charles Dull.
1979. Evaluation of the linden looper and spring cankerworm outbreak on Mammoth Cave National Park, Kentucky. Report No. 79-1-28.
Ghent, John H., and H. Allen Thomas.
1979. The distribution of the introduced sawfly along the Blue Ridge Parkway. Report No. 79-1-29.
Ghent, John H.
1979. Status of southern pine beetle on the Congaree Swamp National Monument. Report No. 79-1-30.
Ghent, John H., and J.D. Ward.
1979. Determination of annual timber mortality; impact of the southern pine beetle. 7/1/78 -2/1/79.
Hammond, B.I., T.P. Russell, and J.L. Wehry.
1979. Report of aerial detection survey: U.S. Department of the Interior, National Park Service, Chickamagua and Chattanooga National Military Park, Georgia, and Tennessee. Report No. 79-3-17.
Hammond, B.I., T.P. Russell, and J.L. Wehry.
1979. Report of aerial detection survey: Osceola National Forest, Florida. Report No. 79-3-19.
Hammond, B.I., T.P. Russell, and J.L. Wehry.
1979. Report of aerial detection survey: Ocala National Forest, Florida. Report No. 79-3-20.
Hammond, B.I., T.P. Russell, and J.L. Wehry.
1979. Report of aerial detection survey: Apalachicola National Forest, Apalachicola and Wakulla Ranger Districts, Florida. Report No. 79-3-21.
Hammond, B.I., D. Barnes, R. Birch, and T.P. Russell.
1979. Report of aerial detection survey: Long Cane Ranger District and Edgefield Ranger District, Sumter National Forest, S.C. Report No. 79-3-29.
Hammond, B.I., S. Myers, and R. Blackburn.
1979. Report of aerial detection survey: Enoree and Tyger Ranger Districts, Sumter National Forest, SC. Report No. 79-3-33.
Hammond, B.I., and W.A. Carothers.
1979. Aerial detection survey of forest insect and disease activity, Bienville National Forest, Mississippi. Report No. 79-3-37.
Hammond, B.I., T.P. Russell, and W. A. Carothers.
1979. Report of aerial detection survey of forest insect and disease activity, Uwharrie National Forest, N.C. Report No. 79-3-38.
Hoffard, William H., William P. Carothers, and John H. Ghent.
1979. Evaluation survey of southern pine beetle infestations on the Oconee National Forest, Georgia. Report No. 79-1-18.
Hoffard, William H.
1979. Pine leaf chermid. Report No. 79-1-23.
Hoffard, William H., Robert L. Anderson, and Ted Oprean.
1979. Evaluation of park beetles and annosus root rot

on the Wolf Creek Dam Plantation, Lake Cumberland, KY. Report No. 79-1-24.
Hoffard, William H., Robert L. Anderson, and William H. Sites.
1979. How to collect and prepare forest insects, disease organisms, and plant specimens for identification. Report No. 79-1-25.
Hoffard, William H., and John H. Ghent.
1979. Biological evaluation of southern pine beetle infestations on the Francis Marion-Sumter National Forests, South Carolina. Report No. 79-1-42.
Hoffard, William H., and R.L. Anderson
1979. Identify and control tree cricket damage.
Hubbard, Susan D.
1979. Resistance screening center test #105-78. Report No. 79-1-4.
Hubbard, Susan D.
1979. Resistance screening test #104-78. Report No. 79-1-5.
Hubbard, Susan D
1979. Resistance screening center test #103-78. Report No. 79-1-6.
Hubbard, Susan D.
1979. Resistance screening center test #1-7-78. Report No. 79-1-7.
Hubbard, Susan D.
1979. Screening center tests #109-78 and #110-78. Report No. 79-1-10.
Hubbard Susan D.
1979. Resistance screening center test #101-78. Report No. 79-1-21.
Hubbard, Susan D.
1979. Resistance screening center test #102-78. Report No. 79-1-22.
Hubbard, Susan D.
1979. Resistance screening center test #106-78. Report No. 79-1-27.
Hubbard, Susan D.
1979. Little chance of pines becoming infected with fusiform rust fungus in screening process except when passed under dilution spray - developmental activity 203-77. Report No. 79-1-31.
Hubbard, Susan D.
1979. Resistance screening center test #108-78. Report No. 79-1-33.
Hubbard, Susan D.
1979. Resistance screening center test #101-79. Report No. 79-1-34.
Hubbard, Susan D.
1979. Resistance screening center test #102-79. Report No. 79-1-35.
Hubbard, Susan D.
1979. Resistance screening center test #111-78. Report No. 79-1-39.
Hubbard, Susan D.
1979. Resistance screening center test #112-78. Report No. 79-1-40.
Hubbard, Susan D.
1979. Resistance screening center test #113-78. Report No. 79-1-41.
Hubbard, Susan D.
1979. Resistance screening center test #103-79. Report No. 79-1-43.
Hubbard, Susan D.
1979. Resistance screening center test #204-79. Report No. 79-1-44.
Hubbard, Susan D.
1979. Developmental test 205-78. Report No. 79-1-45.
Lewis, R., Jr., and F.L. Oliveria.
1979. Live oak decline in Texas. Journal Arboriculture 5:241-244.
Loomis, R.
1979. Insect and disease coordination in forest management. In Proceedings of National Silvicultural Workshop, Charleston, SC. USDA, For. Serv. WO unnumbered. p. 80-86.
Overgaard, N.A., and G.D. Hertel.
1979. Use of insecticides in southern seed orchards during 1978. Report No. 79-2-3.
Overgaard, N.A., and H.N. Wallace.
1979. Spray assessment of insecticide applications at International Paper Company orchards. Report No. 79-1-4.
Overgaard, N.A., and L.R. Barber.
1979. An evaluation of insect damage in Southern Federal seed orchards (1978) (Stuart-LA, Erambert-MS, Ouachita-AR, Beech Creek-NC, Francis Marion-SC, and Ocala-FL). Report No. 79-2-14.
Matthews, F.R., and R.L. Anderson.
1979. Save your fusiform rust infected pines by removing cankers.
Miller, Ralph E.
1979. Loblolly pine die-off status report. Report No. 79-2-8.
Miller, P., and J. Wehry.
1979. Report of aerial detection survey of forest insect and disease activity, St. Francis National Forest, Arkansas. Report No. 79-3-40.
Mistretta, P.A., J.D. Ward, W.A. Carothers, C.W. Dull, and R.F. Bassett.
1979. An evaluation of aerial photography as a method of detection of pitch canker. Report No. 79-3-14.
Mistretta, P.A.
1979. Problem analysis: live oak decline. Report No. 79-3-18.
Mistretta, P.A.
1979. Processing pest samples and diagnostic laboratory procedures. 4 p.
Russell, T.P., and B.I. Hammond.
1979. Report of aerial detection survey of forest insect and disease activity, Croatan National Forest, NC. Report No. 79-3-41.

Sites, William H.
1979. Visit to the Kincaid Recreation Area. Report No. 79-1-19.
Sites, William H.
1979. Preventative measures to protect historic structures. A case history of the Hensley Settlement. Report No. 79-1-20.
Smith, J.D.
1979. Biological evaluation of the SPB on the Tombigbee National Forest in Mississippi. Report No. 79-2-1.
Smith, J.D.
1979. Biological evaluation of the SPB on the Bienville National Forest. Report No. 79-2-2.
Smith, J.D.
1979. Biological evaluation of SPB on the Bankhead National Forest, National Forests in Alabama. Report No. 79-2-6.
Smith, J.D., and George Ryan.
1979. A test of the Kroll and Reeves Regression Model for predicting numbers of SPB infestations in Alabama and Louisiana. Report No. 79-2-11.
Smith, J.D., and D.B. Twardus.
1979. Evaluation of a SPB control tactic: a case study. *In* Symposium on Evaluating Control Tactics for the Southern Pine Beetle Proceedings. USDA For. Serv. Tech. Bul. 1613:106-111.
Stein, C.R., and F.L. Oliveria.
1979. Status of poplar tentmaker in the Lower Mississippi River Delta. Report No. 79-2-7.
Stein, C.R.
1979. Biological evaluation of the SPB on the Tombigbee National Forest in Mississippi. Report No. 79-2-12.
Stein, C.R.
1979. Biological evaluation of the SPB on the Bienville National Forest in Mississippi. Report No. 79-2-13.
Stein, C.R., R.F. Bassett, V. Ellison, M. Smith, W. Jackson, and S. Martinet.
1979. Report of aerial detection survey of forest insect and disease activity, Angelina National Forest, Sam Houston National Forest, Sabine National Forest, and Davey Crockett National Forest, Texas. Report No. 79-3-42.
Swain, K.M.
1979. Minimizing timber damage from hurricanes. Southern Lumberman 239(2968):107-109.
Swain, K.M., and W. Fox.
1979. Control of the SPB on national forests. *In* Symposium on Evaluating Control Tactics for the Southern Pine Beetle Proceedings. U.S. Department of Agriculture Forest Service Technical Bulletin 1613:1-4.
Toko, H.V., and A.E. Landgraf.
1979. Southern pine beetle outbreaks look serious. Forest Farmer 39(2):10-11, 29-30.
U.S. Department of Agriculture, Forest Service.
1979. Canker of Virginia pine in nurseries.
U.S. Department of Agriculture, Forest Service.
1979. Fusiform rust of southern pines.
U.S. Department of Agriculture, Forest Service.
1979. Introduced pine sawfly in the South.
U.S. Department of Agriculture, Forest Service.
1979. Live oak decline and mortality.
U.S. Department of Agriculture, Forest Service.
1979. Pitch canker of pines.
U.S. Department of Agriculture.
1979. Resin soaked root disease of sand pine.
Wehry, R.L., J.F. Bassett, and T.P. Russell.
1979. Report of aerial detection survey: Francis Marion National Forest, South Carolina. Report No. 79-3-32.

Eastern Region (R-9)

Acciavatti, R.E., J.M. Schmid, and D.B. Cahill.
1979. Spruce beetle survey procedures for assessing current, potential, and past Engelmann spruce mortality in the central and southern Rocky Mountains. *In* USDA, Forest Service, Forest Insect and Disease Survey Methods Manual. 8 p.
Acciavatti, R.E., J.R. Terry, and D.R. Bridgewater.
1979. The effectiveness of carbaryl in reducing gypsy moth populations and host damage in eastern Pennsylvania. NA-FR-12.
Allison, J.R., and G.F. Gregory.
1979. How to save Dutch elm diseased trees by pruning. NA-GR-9.
Ford, Robert P.
1979. Loss assessment of white spruce defoliated by yellowheaded spruce sawfly on the Black Ranger District, Chippewa National Forest. NA-FB/M-3, 4 p.
Forest Insect and Disease Management.
1979. A guide to common insects and diseases of forest trees in the Northeastern United States. NA-FR-4, 127 p.
Furniss, M.M., B.H. Baker, R.A. Werner, and L.C. Yarger.
1979. Characterizations of spruce beetle (Coleoptera) infestation in felled white spruce in Alaska, Canada,. Entomophaga 111:1355-1360.
Gregory, G.F., and J.R. Allison.
1979. The comparative effectiveness of pruning versus pruning plus inspection of truck and/or link for therpy of Dutch elm disease in American elms. Journal of Arboriculture 5(1):1-4.
Hastings, A.R., and M.R. Marsh.
1979. Pilot test of the western spruce budworm survey system in the Lake States, first progress report. Report S-5-78, 7 p.

LaMadeleine, L.A.
1979. Evaluation of red pine plantation failures on the Superior National Forest, 1978. Report NA-FR-9, 4 p.
LaMadeleine, L.A.
1979. Evaluation of 3-0 and 4-0 red pine in Eveleth Nursery, Minnesota, 1979. Report NA-TP-2, 4 p.
LaMadeleine, L.A.
1979. Estimating color and grade in black cherry and northern red oak veneer by electrical resistance to a pulsed current. Plywood & Panel Magazine. 3 p.
Lewis, F.B., M.L. McManus, and N.F. Schneeberger.
1979. Guidelines to the use of Gypchek to control the gypsy moth. Research Paper NE-441, 9 p.
Lewis, F.B., R.C. Reardon, A.S. Munson, H.B. Hubbard, N.F. Schneeberger, and W.B. White.
1979. Observations on the use of Gypchek. Research Paper NE-447, 8 p.
Miller-Weeks, Margret, and James R. O'Brien.
1979. Detection survey and evaluation of mortality due to scleroderris canker in New York in 1978. FI&DM Office Report, 4 p.
Munson, A., and R. Reardon.
Effectiveness of three formulations of Dimilin in suppressing the gypsy moth. Report AN-FR-6. 7 p.
O'Brien, James T., and Douglas Stark.
1979. Scleroderris canker found in Maine. Plant Disease Reporter 63(3):194.
Robbins, K., and L.A. LaMadeleine.
1979. Soil-borne pathogen survey of two nurseries in Michigan. Report NA-FB/U-3, 4 p.
Robbins, K., and L. LaMadeleine.
1979. Incidence of eutypella canker on sugar maple on the Argonne Experimental Forest, Rhinelander, Wisconsin, 1978. USDA For. Serv., Northeast Area, S&PF, Broomall, PA. Report NA-FB/M-2, 4 p.
Robbins, K., M. Ostry, and A. Prey.
1979. Pest alert on leaf bronzing of aspen. USDA For. Serv., NCFES, and WI DNR. NA-FB/U-4.
Robbins, Kathryn, and Allen Prey.
1979. Pest alert on armillaria root and butt rot. USDA For. Serv. and WI DNR. NA-FB/U-6.
Robbins, Kathryn.
1979. Pest alert on pine wood nematode. USDA For. Serv., Northeast Area, S&PF, Broomall, PA. NA-FB/U-7.
Robbins, K.
1979. How to identify and minimize damage caused by eutypella canker of maple. USDA For. Serv., Northeast Area, S&PF, Broomall, PA. NA-FR-10.
Walters, J.W., and M.R. Nash.
1979. Evaluation of oak wilt on Necedah National Wildlife Refuge, Wisconsin. USDA For. Serv., Northeast Area, S&PF, Broomall, PA. Rep. NA-FR-8, 15 p.
Whyte, G. Lynne.
1979. Spruce budworm damage in spruce plantations on the Nicolet National Forest, 1978. USDA For. Serv., Northeast Area, S&PF, Broomall, PA. NA-FR-11, 7 p.
Whyte, G. Lynne.
1979. Pest alert on jack pine budworm. USDA For. Serv., Northeast Area, S&PF, Broomall, PA. NA-FB/U-4.
U.S. Department of Agriculture.
1979. Gypsy moth news. USDA, Forest Service, NA, S&PF and NA-FR-S, 15 p.
U.S. Department of Agriculture, Forest Service.
1979. Draft environmental statement for cooperative gypsy moth suppression and regulatory programs, 1980 activities. USDA, Forest Service and APHIS, 73 p.

Alaska Region (R-10)

Holsten, E.H.
1979 (Nov.). Large aspen tortrix, Willow, Alaska. Biological Evaluation R10-79-3. 9 p.
Holsten, E. H., and K.P. Zogas.
1979 (Nov.). Spruce beetle-Summit Lake, Dry Gulch, Cooper Landing. Biological Evaluation R10-79-4. 18 p.
Holsten, E.H., and R.L. Wolfe.
1979 (Jan.). Spruce beetle risk rating system for white spruce on the Kenai Peninsula, Chugach National Forest. Technical Report R10-1. 21 p.
Holsten, E.H., and K.P. Zogas.
1979 (Oct.). Screening of synthetic lepidopteran pheromones, South-central Alaska. Technical Report R10-2. 11 p.
Holsten, E.H.
1979 (Oct.). Supplement spruce beetle risk rating system for white spruce on the Kenai Peninsula, Chugach National Forest. Technical Report R10-3. 10 p.
Holsten, E.H., K.P. Zogas, and R.L. Wolfe.
1979 (Jan.). Resurrection Creek spruce beetle infestation: a three-year interim report. Misc. Report. 19 p.
Holsten, E.H.
1979 (June). Birch leaf rollers. Leaflet No. 64. 9 p.
U.S. Department of Agriculture, Forest Service, Alaska Region.
1979 (Aug.). Forest Insect and Disease Conditions in Alaska in 1978. Report No. 62. 35 p.
Wilson L.W., and Robert D. Averill.
1979. Redheaded pine sawfly. Forest Insect and Disease Leaflet.

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